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Torrey Botanical Club

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THE OLDEST BOTANICAL JOURNAL OF THIS HEMISPHERE
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BULLETIN OF THE TORREY BOTANICAL CLUB

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The status of *Hierochloë Nashii* and its relationship to *H. odorata*[1]

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Abstract

REEDER, JOHN R. and KNUT J. NORSTOG. (Osborn Bot. Lab., Yale U., New Haven, Conn. and Wittenberg U., Springfield, Ohio.) The status of *Hierochloë Nashii* and its relationship to *H. odorata*. Bull. Torrey Bot. Club 88(2): 77–84. Illus. 1961.—A critical comparison of the type specimens of *Hierochloë Nashii* and *H. odorata* forma *Eamesii* reveals that there are no important morphological differences between them. Although these two taxa have been considered to be extremely local in occurrence, the former from New York and New Jersey, and the latter only from Fairfield, Connecticut, plants corresponding to the types have been found in widely separated localities along the Connecticut coast. Plants of the "Nashii-Eamesii" type were never encountered as isolated subpopulations, but rather as scattered individuals within the stands. *Hierochloë odorata* from elsewhere is usually very uniform and apparently highly infertile, reproducing either apomictically or by rhizomes or both. The extremely variable populations of coastal Connecticut, in contrast, are quite fertile and have normal embryo sac development. Cytological studies of plants from coastal Connecticut revealed that they have the same chromosome number ($2n = 28$) as the uniform and apparently infertile *Hierochloë odorata* from Europe and northern North America. In contrast, the equally uniform and infertile apomicts from Ohio and Michigan have a chromosome number of $2n = 56$. *Hierochloë Nashii* and *H. odorata* forma *Eamesii* are shown to be merely extreme variants of *H. odorata* in the highly variable coastal populations of northeastern North America.

The common Sweetgrass, *Hierochloë odorata* (L.) Beauv., is widely distributed in arctic and temperate regions throughout the northern hemisphere. It is a species of moist habitats and ordinarily does not form extensive stands, but occurs as more or less isolated patches in moist meadows, bogs or in the mountains on wet seeps. For the most part it appears to be a rather well-defined species and the morphological characters are relatively uniform in plants from areas which are widely separated geographically.

Hierochloë is a member of the tribe Phalarideae, having three-flowered spikelets in which the two lower florets are staminate and the upper one perfect. In *H. odorata* the glumes and staminate florets are of about equal length, while the perfect floret is slightly shorter. Both the glumes and lemmas are usually described as awnless, but short awns may occur on the lemmas of the staminate florets and, in fact, are rarely lacking in all of the spikelets of an inflorescence. The panicle is pyramidal, of a bronze color, usually not more than 10 or 12 cm. in length, although individuals with inflorescences 15 or more cm. long do occur. These characteristics give to *H.*

[1] This research was supported in part by a grant awarded by the National Science Foundation to the junior author, who was a NSF Faculty Fellow at Yale University during the academic year 1959–60. We are grateful to the curators of the Gray Herbarium and The New York Botanical Garden for the loan of herbarium material.

odorata a distinctive appearance, and it is recognized readily in the field. In the eastern United States this species is one of our earliest grasses, flowering in April and May. *H. alpina* (Swartz) Roem. & Schult., its closest relative, has a more contracted panicle and the staminate lemmas bear awns 5 to 8 mm. long. Both *H. odorata* and *H. alpina* were known from eastern North America before the mid-19th century.

In 1898, Eugene Bicknell described a species of *Hierochloë* which he had discovered in flower on July 11th of the previous year in Van Cortlandt Park, New York City. He proposed for it the name *Savastana Nashii* [= *Hierochloë Nashii* (Bicknell) Kaczmarek]. He indicated that the fertile culms were much taller than those of *H. odorata*, that the leaves were more numerous and very much longer, and that the panicle was larger and incomparably looser. He stressed that plants representing his proposed new species bloomed much later than is usual for *H. odorata*, stating that on August 8th *H. Nashii* was still in flower, while withering specimens were collected on September 18th. He pointed out that at the time of his first collection (July 11th) plants of *H. odorata* growing nearby had both culm leaves and panicles dried and brown.

Although accepted as a valid species by a number of authors (Taylor 1915, Nash 1913, Fernald 1917, 1950, House 1923, 1924), apparently *Hierochloë Nashii* was never considered to be specifically distinct by agrostologists at the U. S. National Herbarium. Hitchcock (1908, 1935) and Chase (1950) both treated it as a synonym of *H. odorata*. It is rather curious that although *H.* (or *Savastana*) *Nashii* was described more than 60 years ago and was based on plants from an easily accessible area, there are no specimens so labelled either at the New York Botanical Garden nor at the Gray Herbarium except for those which were collected in Van Cortlandt Park by Bicknell himself in 1897.

In 1910 and again in 1914, Dr. E. H. Eames collected some unusual specimens of *Hierochloë* in Fairfield, Connecticut. These were originally distributed as *Savastana Nashii*, but some years later Fernald (1917) described this material as forma *Eamesii* of *Hierochloë odorata*. Fernald indicated that the Eames plants represent only an extreme development of *H. odorata* var. *fragrans* rather than "the beautifully distinct" *H. Nashii*. All of the Eames specimens were collected in May.

In the eighth edition of Gray's Manual, Fernald (1950) maintained *Hierochloë Nashii* as a distinct species and also recognized *H. odorata* forma *Eamesii*. In this work, however, he has abandoned the use of the designation var. *fragrans*. Neither Hitchcock (1950) nor Gleason (1952) recognized *H. Nashii* as specifically distinct. Since authorities are not in agreement with respect to the status of this species, additional study of the problem seemed indicated. The treatment of Fernald (1950) is of particular interest in that it is the most recent work in which *H. Nashii* is recognized. Fernald indicates

that the staminate lemmas are short awned (to 1 mm.), the cauline leaves are more numerous (3–6), elongate, and firm, and the ligules are 5–7 mm. in length. He states that the flowering period is July to August and that the flowering culms are firm and persistent. In contrast, the staminate lemmas of *H. odorata* (including forma *Eamesii*) are said to be awnless, the 2–3 cauline leaves are short, soft and lanceolate, the ligules are only 1-2 mm. long, while the culms are soft and wilt soon after anthesis. In Connecticut and southern New York, this species begins to flower in early spring.

As a first step in this study, the authors have examined critically the type specimens of *Hierochloë Nashii* and *H. odorata* forma *Eamesii*. In general appearance they are strikingly similar, and it is quite easy to understand why Eames' specimens were originally determined as *H. Nashii*. The results of a comparison of these type specimens are presented in table 1.

TABLE 1. *A comparison of the type specimens of* **Hierochloë Nashii** *(E. P. Bicknell, July, 1897) and* **H. odorata f. Eamesii** *(E. H. Eames #8734).*

	H. Nashii	*H. odorata f. Eamesii*
Height of plant	76 cm.	90 cm.
Length of panicle	25 cm.	38 cm.
Length of lowermost panicle branch	14–15 cm.	15–16 cm.
Number of culm leaves	4[a]	4–5
Length of first leaf below panicle	12.5 cm.	12.5 cm.
Length of ligule	6 mm.	5–6 mm.
Length of spikelet	6–7 mm.	5.5–6.5 mm.
Length of awn (maximum)	1 mm.	0.2 mm.

[a] An isotype (GH) has only 4 culm leaves, but a specimen at NY, collected in August, 1897 by Bicknell, has 7.

As can be seen from the above, the differences between these specimens are scarcely of the order which would suggest that they represent two distinct species. It is interesting to note that whereas Bicknell (1898) indicated that *Hierochloë Nashii* had "much taller" culms, actually in the isotype these are shorter than those of the holotype of *H. odorata* forma *Eamesii*. It should be pointed out also that in the type material of *H. Nashii* seen by the writers, the number of culm leaves was no greater than 4, and this number is equalled by *H. odorata*. The greatest difference is, perhaps, in the awns on the staminate lemmas which reach a length of 1 mm. in *H. Nashii*, while in the type of *H. odorata* forma *Eamesii* awns no longer than 0.2 mm. were found. As will be discussed later, however, the writers have seen specimens of *H. odorata* which have awns as much as 1.5 mm. in length. The difference in awn length between these two type specimens would appear, therefore, to be of only minor significance. The chief distinction between *H. Nashii* and *H. odorata* forma *Eamsii* thus seems to rest not upon gross morphological differences, but rather on the later flowering period (July, August) of *H. Nashii*.[2] The possibility that there might be cytological differences was also considered.

[2] Perhaps this has received undue emphasis. Although Bicknell indicated that his plants were in full flower in July, examination of his specimens revealed spikelets well

past anthesis. Furthermore, when the writers visited the Connecticut populations on July 1st, they found a number of culms still green and upright, although the majority had become brown and withered.

In an attempt to observe and collect living material of *Hierochloë Nashii*, the authors visited the type locality (Van Cortlandt Park) in May and again in early July. In spite of an intensive search, however, no *Hierochloë* was located. A trip was also made to Lake Como, New Jersey, another station for *H. Nashii* according to Taylor (1915). In this case also the search was fruitless. Both of these areas are public parks, and have been so modified in recent years that the habitats which originally favored *Hierochloë* probably no longer exist.

According to Dr. David Fairbrothers (personal communication) there are no specimens of *Hierochloë Nashii* in the Rutgers University Herbarium. He indicates also that he has examined several populations of *Hierochloë* in New Jersey but has found no plants with large open panicles. The New Jersey plants, he reports, show little variation, for three morphological characteristics studied, the exception being the awn length which ranged from 0 to 1.1 mm.

Along the Connecticut coast *Hierochloë* is rather common, and the writers together located 9 separate populations between the towns of Stamford and Guilford, a distance of some 75 miles. The first visit to these areas was made in early May and the last on July 1. All of these populations were in brackish meadows and although a search for *Hierochloë* was made inland, no stands were located. During the early trips the writers collected spikelets for cytological investigation, and an attempt was made also to

Fig. 1. Photograph of flowering culms each from a different population of *Hierochloë* along the Connecticut coast. Note that all have a relatively long and loose inflorescence.

locate plants with loose and open inflorescences which would fit the description of *H. odorata* forma *Eamesii*. At first none were found, but as the season progressed, plants of the "Eamesii" type were encountered with increasing frequency. It is interesting to note that these never occurred as small subpopulations, but rather as scattered individuals. Fig. 1 is a photograph of 5 of these, each from a separate locality. Note that the uppermost leaf in most cases is elongate, a character used in the separation of *H. Nashii*.

In order better to understand the variability among individuals within a single population, a random sample of 28 individuals was made in the Guilford stand. This particular locality was chosen since it was the most recent patch discovered and plants with very long and loose inflorescences had not yet been "weeded out." Also it seemed to exhibit a high degree of variability. The sample was made on May 26, the method used being to run a transect through the population and collect a flowering culm at intervals of 2 meters. These plants were then scored with respect to 5 characters and the data arranged in the form of a pictorialized diagram (fig. 2) according

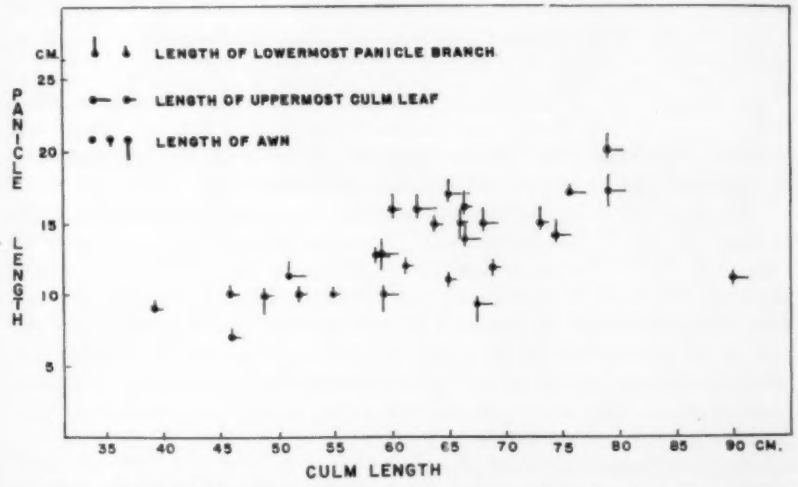

Fig. 2. Pictorialized scatter diagram of a random sample of 28 plants from a stand of *Hierochloë* near Guilford, Connecticut. This appeared to be the most variable of the 9 populations studied.

to the method described by Anderson (1949). It is quite apparent that although the population exhibits considerable variability with respect to these characters, they do not cluster in a manner which suggests that two distinct taxa are involved. Fig. 3 is a photograph of 7 plants from the Guilford population arranged to show the variation in size and looseness of the inflorescences. The length of panicle is seen to vary from about 7 cm. to 38 cm. There is also considerable difference in the length of the upper culm leaf

Fig. 3. Photograph of flowering culms from the Guilford population to show the range of variation.

(from about 2 cm. to 13.5 cm.). Note that there is no direct relationship between panicle length and leaf length. Plant number 6 with a panicle 25 cm. long is subtended by a leaf of only 7.5 cm., whereas in plant number 3 the panicle and leaf lengths are 12 and 9 cm. respectively.

Not all of the 9 populations studied showed the extreme variation found at Guilford, but in all of them patient search revealed some plants of the "Eamesii type." The most variable populations were at Stamford, East Norwalk, Fairfield, Guilford, and East Haven, while at Rowayton, Norwalk, Bridgeport, and New Haven they were somewhat more uniform. The one at New Haven is probably as uniform as any of those visited, but even here some individuals would fit Fernald's designation of *Hierochloë odorata* forma *Eamesii*. Fig. 4 is a pictorialized scatter diagram representing a random sample from this locality, and dotted in is an approximate outline of the Guilford sample for comparison.

For the cytological examinations, slides were made of pollen grains in mitotic metaphase, using the aceto-carmine squash method. Material from the 9 coastal Connecticut populations, including some plants with very loose panicles, all proved to be tetraploid, having a chromosome number of $2n = 28$. This is the number reported for *Hierochloë odorata* from Europe and North America, with the exception of certain populations in New Jersey (Myers, 1947),[3] Michigan, and Ohio (Norstog 1960) which have been found to be octoploid ($2n = 56$).

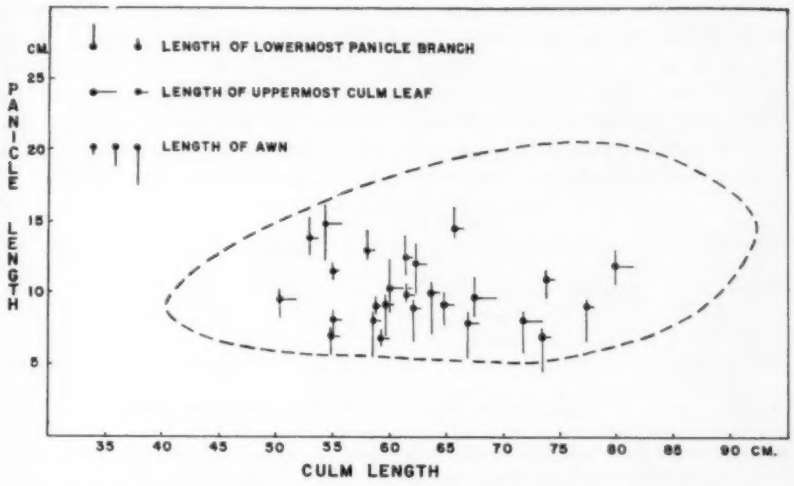

Fig. 4. Pictorialized scatter diagram of a random sample of 26 plants from a stand of *Hierochloë* near New Haven, Connecticut. This appeared to be the least variable of the 9 populations studied. The dotted line represents an approximate outline of the diagram of the Guilford sample.

In general, *Hierochloë odorata* appears to produce relatively few caryopses. Dr. Thorv. Sørenson of the Universitetets Botaniske Laboratorium, Copenhagen, reports (personal communication) that material of this species which he has examined in Scandinavia is extremely infertile. The junior author has examined material from a population in southern Iceland and was able to find very few caryopses. In these cases propagation must be chiefly vegetative by means of the strong and aggressive rhizomes which are characteristic of the species. This method of reproduction would account also for the high degree of uniformity which one finds among individuals from these areas.

Recent studies have revealed that the octoploid populations of *Hierochloë odorata* from Ohio and Michigan produce their caryopses apomictically, the embryo sacs being formed solely by apospory (Norstog 1960). These plants are pollen sterile, abortion occurring at the time of the first mitotic division following meiosis. The populations are relatively uniform, and again the percentage of caryopses which mature is quite low.

By contrast, in the coastal Connecticut plants microsporogenesis and megasporogenesis appear to occur in a normal manner. This has been determined by a study of slides prepared from flowers in various stages of de-

[3] In this paper a count of $2n = 56$ for *Hierochloë odorata* is credited to Church "unpublished". Although there is no indication of the source of the material, in a personal letter to the junior author, Dr. Church states that the plants came from New Jersey.

velopment. An examination of the stigmatic hairs in these plants following anthesis has shown that pollen tubes are formed regularly. There is no reason to suppose that these plants are not completely fertile since "seed set" in some inflorescences approaches 100 per cent. The caryopses are well filled and germinate readily. Thus we have an explanation for the high degree of variability in the coastal Connecticut *Hierochloë* populations as contrasted with the great uniformity seen in this species from other areas.

Literature Cited

Anderson, Edgar. 1949. Introgressive hybridization. New York: J. Wiley & Sons Inc. ix + 109 pp.

Bicknell, E. P. 1898. Two new grasses from Van Cortlandt Park, New York City. Bull. Torrey Bot. Club **25**: 104–107.

Chase, Agnes. 1950. (see Hitchcock, A. S. 1950)

Fernald, M. L. 1917. Some new or critical plants of eastern North America. Rhodora **19**: 152–155.

————. 1950. Gray's Manual of Botany. 8th edition. New York: American Book Co. lxiv + 1632 pp.

Gleason, H. A. 1952. The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada. 3 vol. Lancaster, Penna.: Lancaster Press, Inc. (Gramineae, **1**: 96–246).

Hitchcock, A. S. 1908. Gramineae. *In:* Robinson, B. L. and M. L. Fernald, Gray's New Manual of Botany. 7th edition. New York: American Book Co. pp. 86–171.

————. 1935. Hierochloë. *In:* North American Flora **17**(5): 367–369.

————. 1950. Manual of the Grasses of the United States. 2nd edition (Revised by Agnes Chase). U. S. Dept. Agric. Misc. Publ. 200. 1051 pp.

House, H. D. 1923. Nomenclatorial notes regarding certain New York State plants. New York State Mus. Bull. 243–244: 58–70.

————. 1924. Annotated list of the ferns and flowering plants of New York State. New York State Mus. Bull. 254. 759 pp.

Myers, W. M. 1947. Cytology and genetics of forage grasses. Bot. Rev. **13**: 319–421.

Nash, G. V. 1913. Gramineae. *In:* Britton, N. L. and A. Brown, An Illustrated Flora of the Northern United States, Canada, and the British Possessions. 2nd edition. New York: Charles Scribner's Sons. **1**: 107–295.

Norstog, K. J. 1960. The occurrence and distribution of *Hierochloë odorata* in Ohio. Ohio Jour. Sci. **60**: 358–365.

Taylor, N. 1915. Flora of the vicinity of New York. Mem. New York Bot. Gard. **5**: vi + 683 pp.

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The ultra-structure of sieve plates of *Macrocystis pyrifera*

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PARKER, JOHNSON and DELBERT E. PHILPOTT. (Greeley Mem. Labs., Yale U., New Haven, Conn.) The ultra-structure of sieve plates of *Macrocystis pyrifera*. Bull. Torrey Bot. Club 88(2): 85–90. Illus. 1961.—Light microscope studies of fresh and preserved material of *Macrocystis pyrifera* showed that strands of cytoplasm or of cytoplasm-like material could be seen approaching, but not penetrating the sieve plates of the sieve tubes, especially when such cells were stained with certain compounds like magdala red and alizarin red. Occasionally bodies resembling chromoplasts were found in the cytoplasm of sieve tubes and accumulated formazan, the reduced form of tetra-zolium chloride. Aniline blue or mercuric bromphenol blue stained the callose but did not reveal strands penetrating the pores of the sieve plates. Electron microscope studies of the sieve tubes revealed that plates were penetrated with strands of an electron dense material and that the pores of the plates are not unobstructed. Whether the sieve plate was layered with callose or not, the penetrations of the pores appeared to be a continuous extension or web of material resembling the endoplasmic reticulum.

Macrocystis pyrifera (L.) C. A. Agardh, the giant kelp of the west coast of North America, is unusual for its great length as well as its large sieve-tube-like elements, closely resembling those of certain higher plants (Oliver 1887; Esau 1939). Presumably such "sieve tubes"[1] can transport large amounts of organic solutes down to the region of the holdfast (Sargent and Lantrip 1952). Since a great deal of controversy has centered around the mechanism of organic solute transport in vascular plants, it seemed of special interest to examine the ultra-structure of sieve plates in the sieve tubes of this brown alga, and the new electron microscope methods offered a means of such a study.

MATERIALS and METHODS. Material was collected from the Straits of Juan de Fuca near Twin on the north coast of the Olympic Penninsula, Washington. Stipe material was cut into 2 cm. lengths and then sectioned longitudinally for observation under the light microscope. Some of the stipe material was preserved in 10 per cent formaldehyde in sea water for other light microscope work and for later embedding for electron microscope studies.

For the light microscope studies the following compounds were used as stains or reactants: 2, 3, 5-triphenyl tetrazolium chloride at 1 per cent in sea water, magdala red (Grubler) at 0.05 per cent in distilled water, alizarin

[1] According to Wille, Oliver, and others cited by Esau (1939), true sieve tubes in certain of the brown algae form a zone around the medulla, while "sieve hyphae" or "trumpet hyphae" occur in the medulla.

red S (National Aniline Division) at 0.05 per cent in distilled water, aniline blue (unknown mfg.) at 0.01 per cent in distilled water, and bromphenol blue (unknown mfg.) at 0.1 per cent with $HgCl_2$ at 10 per cent together in distilled water according to the method of Mazia et al. (1953). One cm.-long stipe pieces were soaked in tetrazolium choloride solution for 18 hr., then sectioned. In the case of the other compounds, sections were first made, then soaked for 15 min. in one of the dye solutions.

For the electron microscope studies, stipe pieces about 5 cm. long were preserved in formaldehyde and brought to Woods Hole the following summer. Cross sections of the stipe were made with a razor blade. These sections were trimmed to 1 mm. square and put directly into 25 ml. of 5 per cent $KMnO_4$ in distilled water for 10 min. at 22° C. according to the method of Mollenhauer (1959). After dehydration in a series of graded alcohol solutions and passage through a sequence of methacrylate and alcohol mixtures as described by Mollenhauer, they were finally put in 1:3 methyl and butyl methacrylate with catalyst. The junior author found that it was possible to avoid bubbles in the methacrylate on hardening by using partially prepolymerized methacrylate which was still liquid although quite viscous. This was added to the gelatin capsules on top of the section in each capsule to which a drop of unprepolymerized methacrylate had already been added. Capsules were then capped and heated at 44° C. for 8 hr. Sections were cut for electron microscopy with a diamond knife, longitudinal to the axis of the plant, on a heat-expansion type of microtome (Philpott 1955), and mounted on carbon-strengthened collodion-coated grids. These were observed in an R.C.A. Model E.M.U.-2B electron microscope.

RESULTS. Under the light microscope at 450 ×, it was possible to discern strands of cytoplasm or of similar material occurring adjacent to the sieve plates and running parallel to the lateral cell walls. Such strands could also be seen entering but not penetrating the callose when the sieve plates were covered with callose. Strands were more readily visible when stained with magdala red or alizarin red S in fresh material, but penetration of the callose or of the cell wall by such strands was still uncertain. Aniline blue or mercuric bromphenol blue stained the callose bodies a distinct blue, but this did not clarify the condition of the strands either.

A few plastids were occasionally visible in some of the sieve tubes. Some of these were clearly pigmented a greenish brown, suggesting that they were chromoplasts. Tetrazolium chloride in its pink reduced form was found to accumulate in such plastids, suggesting a site of respiratory activity.

The electron microscope studies clearly showed that part of the cytoplasmic material passed through the sieve plates. This is illustrated in fig. 1 and 2. In spite of callose formation, this material, of a net-like nature, can be seen to pass through the callose and cell wall (fig. 1). The net-like

Fig. 1. A portion of the sieve plate in longitudinal section together with contents of adjacent sieve tube elements. The sieve plate with considerable callose passes from upper left to lower right and is penetrated by pores filled with extensions of a cytoplasmic network occurring adjacent to the plate. Inset shows an enlargement of one of these pores. Original Mag. 5,200; final, 18,200. Inset, 36,400.

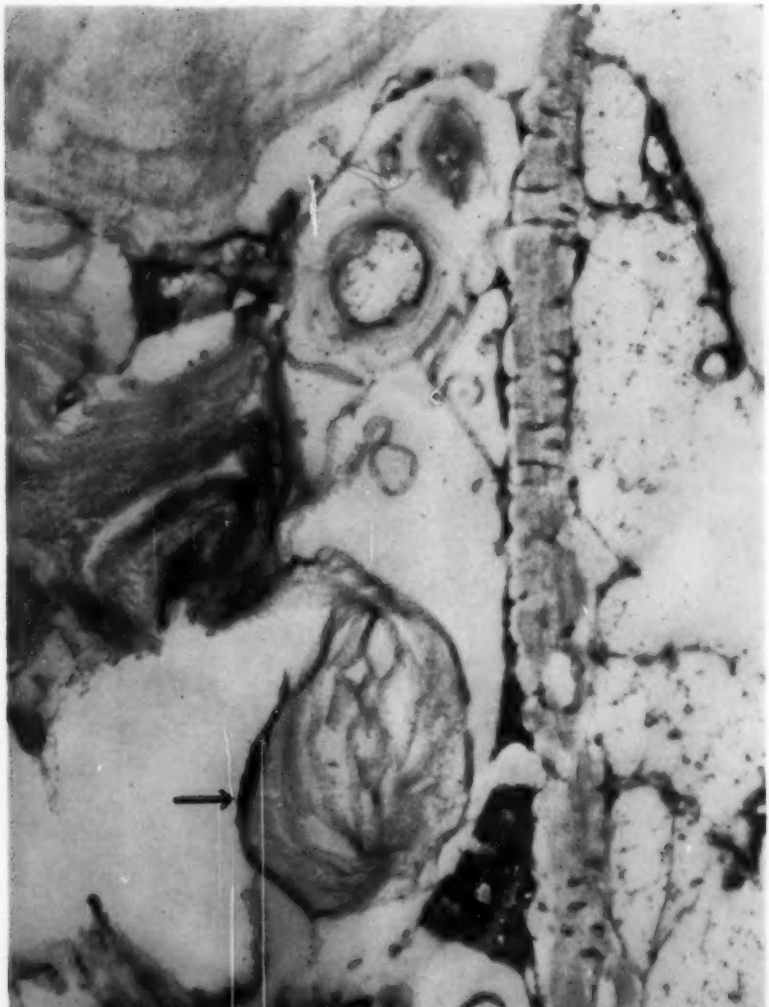

Fig. 2. A sieve plate without callose accumulation is shown in longitudinal section passing from top to bottom of picture. A relatively electron-dense material can be seen penetrating pores in the sieve plate. Lamellated bodies (at end of arrow) are suspected of being plastids. Original Mag. 3,300; final, 17,500.

material has some resemblance to the endoplasmic reticulum of Porter (1953). The lamellar material appearing somewhat away from the sieve plate in figure 1 is of unknown nature. Although lamellate like chromoplasts, it bears no resemblance to chromoplasts observed by the writers in *Fucus vesiculosus*.

In fig. 2 a sieve plate is shown in which there is no callose accumulation. In this case, in at least one place, a cytoplasmic material can be seen penetrating the cell wall from one side to the other. Some of the material to the left of the plate, for example the oval body at end of arrow in fig. 2, may be chromoplasts.

DISCUSSION. As a result of the present study as well as those of various workers with the light microscope (reviewed by Esau et al. 1957) and with the electron microscope in cucurbits (Hepton et al. 1955) and in *Betula* (Volz 1952), it is difficult to see how a rapid mass-transport of solutes can occur through such cells. Kollmann (1960a) recently showed that true sieve tube elements in a species of *Passiflora* can be plasmolyzed so that the cytoplasm comes away from the sieve plates, thus seeming to deny a direct vacuolar connection which one would assume to be necessary for the mass-flow system of Münch (1930) to function efficiently. The electron microscopic studies of Kollmann (1960b) revealed that the sieve plate pores were penetrated by cytoplasmic material of a lamellar nature. This agrees with the findings of Ziegler (1960) in a species of *Heracleum*. Kollmann concluded that his observations cast doubt on the idea of the sieve tubes playing only a passive role in translocation. In spite of this, mass flow is known to occur from the phloem of certain trees for more than an hour when the bark is cut open (Zimmermann 1957). It has also been shown that aphids are able to locate sieve tubes among other cells and when their stylets are severed, the part in the bark continues to exude for some time afterwards (reviewed by Zimmermann 1960).

In the brown algae, even though of vastly different evolutionary background, a similar morphological situation seems to exist. So far, however, a mass flow has not been conclusively proven to occur in any of the brown algae. Some years ago Bodenberg (1928) showed that lithium salts (detectable in a spectroscope) would not move any faster through the sieve tubes of *Nereocystis* than they could by diffusion alone. Nevertheless, Sargent and Lantrip's (1952) growth studies suggested that mass transport of photosynthate must occur in *Macrocystis*. In fact, Crafts (1939) claimed that exudation from sieve tubes in *Macrocystis* could readily be observed. But in repeating these experiments we found that the same effect could be produced in any of the Laminariales by loss of slime from the stipe surface or in some cases from slime ducts. Studies with P^{32} in *Fucus* (Parker 1956) supported the findings of Bodenberg with lithium in *Nereocystis*, i.e., P^{32} as phosphate did not move any faster than could be accounted

for by simple diffusion. It is possible that such experiments fail to show transport because of ion absorption on polysaccharides.

Although a mass flow in *Macrocystis* appears theoretically possible, there are no unobstructed pores in the sieve plates of this species according to our observations. If a mass flow does occur, one wonders why carbohydrates could not diffuse out into the water. Perhaps the strands of cytoplasm play some role in maintaining carbohydrate gradients which would not occur if the cells were dead and empty.

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Literature Cited

Bodenberg, E. T. 1928. Experiments on conduction in *Nereocystis leutkeana*. Publ. Puget Sound Biol. Sta. **5**: 252–256.

Crafts, A. S. 1939. The relation between structure and function of the phloem. Amer. Jour. Bot. **26**: 172–177.

Esau, K. 1939. Development and structure of the phloem tissue. Bot. Rev. **5**: 373–432.

———, **Currier, H. B.**, and **V. I. Cheadle.** 1957. Physiology of phloem. Ann. Rev. Plant Physiol. **8**: 349–374.

Hepton, C. E. L., R. D. Preston, and **G. W. Ripley.** 1955. Electron microscopic observations on the structure of the sieve plates in *Cucurbita*. Nature **176**: 868–870.

Kollmann, R. 1960a. Untersuchungen über das Protoplasma der Siebröhren von *Passiflora coerulea*. I. Lichtoptische Untersuchungen. Planta **54**: 611–640.

——— 1960b. Untersuchungen u.s.w., II. Elektronoptische Untersuchungen. Planta **55**: 67–107.

Mazia, D., P. A. Brewer, and **M. Alfert.** 1953. The cytochemical staining and measurement of protein with mercuric bromphenol blue. Biol. Bull. **104**: 57–67.

Mollenhauer, H. H. 1959. Permanganate fixation of plant cells. Jour. Biophys. & Biochem. Cytol. **6**: 431–435.

Münch, E. 1930. Die Stoffbewegungen in der Pflanze. G. Fischer, Jena.

Oliver, F. W. 1887. On the obliteration of the sieve-tubes in Laminariaceae. Ann. Bot. **1**: 95–117.

Parker, J. 1956. Translocation of P^{32} and dye behavior in two species of marine algae. Naturwiss. **43**: 452.

Philpott, D. E. 1955. A simple economic microtome for ultra-thin sectioning. Exp. Med. & Surg. **13**: June 1955.

Porter, K. R. 1953. Observations on a submicroscopic basophilic component of cytoplasm. Jour. Exp. Med. **97**: 727–749.

Sargent, M. C. and **L. W. Lantrip.** 1952. Photosynthesis and translocation in giant kelp. Amer. Jour. Bot. **39**: 99–107.

Volz, Gertrud. 1952. Elektronmikroskopische Untersuchungen über die Porengrössen pflanzlicher Zellwände. Mikroskopie **7**: 251–266.

Ziegler, H. 1960. Untersuchungen über die Feinstruktur des Phloems. I. Die Siebplatten bei *Heracleum mantegazzianum* Somm. et Lev. Planta **55**: 1–12.

Zimmermann, M. H. 1957. Translocation of organic substances in trees. II. On the translocation mechanism in the phloem of white ash. (*Fraxinus americana* L.). Plant Physiol. **32**: 399–404.

——— 1960. Absorption and translocation: transport in the phloem. Ann. Rev. Plant Physiol. **11**: 167–190.

BULLETIN OF THE TORREY BOTANICAL CLUB

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A new *Sclerospora* on *Iseilema laxum*

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SRINIVASAN, M. C., M. J. NARASIMHAN AND M. J. THIRUMALACHAR. (Mallaswaram, Bangalore, India). A new *Sclerospora* on *Iseilema laxum*. Bull. Torrey Bot. Club 88(2): 91–94. Illus. 1961.—A new *Sclerospora* species, ***Sclerospora westonii*** **sp. nov.**, is described growing on the leaves of *Iseilema laxum* in low-flying, water-stagnant areas near Poona, India.

A *Sclerospora* species severely infecting culms of *Iseilema laxum* Hack, a common forage grass, was collected near Poona, India, during the months of July and August. The infected plants were found mostly in low-lying, water-stagnant areas. The diseased plants were conspicuous by their upright stunted growth, proliferation of the spikelets and characteristic leaf shredding.

Soon after the monsoon rains in June, symptoms appeared on young leaves as pale yellow streaks, particularly conspicuous on the top leaves. The conidial stage, formed on the infected leaves during early hours of the morning, was sparse, small, and quite inconspicuous. The remnants of the collapsed conidiophores could hardly be made out during the day. As the season advanced, the conidial stage was replaced by the sexual stage. The pale-yellow streaks on the leaves became black or leaden-grey in color, and when examined microscopically showed numerous oospores. In due course, due to the extensive development of oospores between the vascular tissues, the parenchyma collapsed and the old leaves were left in shredded condition.

Conidial stages were observed from material collected in the field during early hours of the morning as well as those that were incubated in humid conditions as suggested by Thirumalachar and Narasimhan (1952). A temperature of about 240°C. was favorable for maximum conidial development. As pointed out by Safeeulla and Thirumalachar (1956), the periodicity factor in conidial production could be changed by providing the necessary conditions for spore development.

The conidial stage is formed chiefly on the lower leaf surface in areas where moisture has condensed as fine droplets. The branching of the conidiophores is simple in contrast to many of the species of *Sclerospora*. In *S. dichanthicola* Thirum. & Naras. it was pointed out that the conidiophore branching was much reduced and the stout tree-like branching of other *Sclerospora* species was absent. The species under study shows a similar condition. Most of the conidiophores are simple, with slight tendency for lobing at the tip. On the expanded apices, 2 to 3 sterigmata are borne (fig. 2, 3). In highly developed conidiophores, the primary branches show as bifurcations at the apex, and the secondary branches appear as lobings at

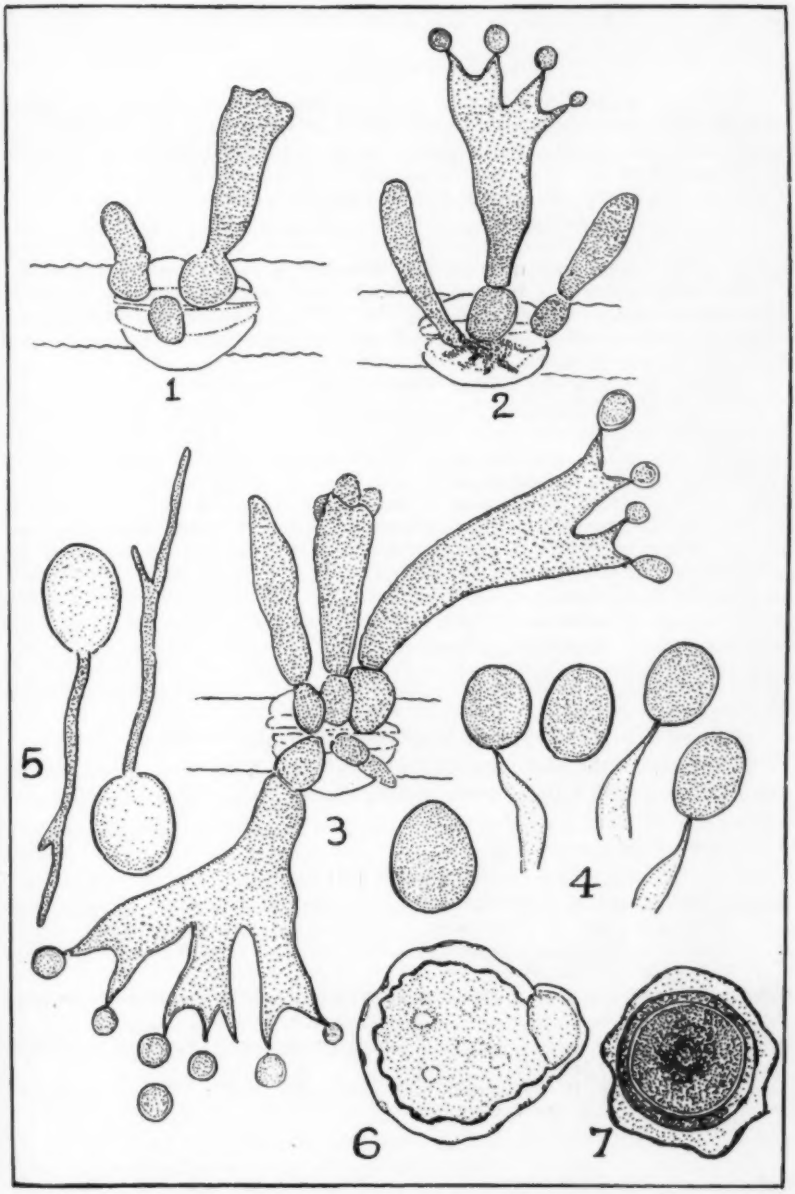
the tip, bearing numerous sterigmata. The basal foot cell of the conidiophore is quite conspicuous and emerges out of the stoma as a bulbous structure (fig. 1).

The conidia are spherical, subglobose or ovate and borne on the sterigmata (fig. 4). They are easily detached and germinate almost immediately by the formation of long germ tubes (fig. 5). There is no apical papilla as in the case of sporangial types, which germinate indirectly. Freshly-formed conidia were placed on slides for germination and incubated at temperatures varying from 12° to 36° C. There was no germination at temperatures above 36° C. and in all cases only germ tubes were formed.

Sex organs are differentiated in mature leaves within the parenchyma. Oogonia are spherical, thick-walled, 40–50 micra in diameter, with granular contents. Antheridia are formed in close juxtaposition, adpressed to the oogonial wall (fig. 6). The oospores are golden-brown, thick-walled, 23–29 micra in (inner) diameter with walls 6–9 micra thick. The persistent wall of the oogonium forms a loose outer envelope for the oospore (fig. 7). Germination of the oospore has not been observed.

As regards the identity of the fungus, comparisons have to be made with the conidial forms of *Sclerospora*. *S. maydis* (Racib) Butler, *S. philippinensis* Weston, *S. spontanea* Weston, and *S. sacchari* Miyake occur on sugarcane and corn, and have conidiophores with well-developed branching systems. *S. nobeli* Weston and *S. andropogonis-sorghi* (Kulk). Kulk, which occur on *Sorghum* species are also quite distinct. Oosporic stages alone on grasses have been reported for *S. farlowii* Griff. on *Chloris elegans* and *S. northii* Weston on *Erianthus maximum*. *S. butleri* Weston on *Eragrostis* sp. was shown by Thirumalachar and Whitehead (1952) to be a species of *Basidiophora*. The fungus under study, however, closely resembles *S. dichanthicola* Thirum. & Naras. which infects *Dichanthium annulatum* in India and occurs only in the conidial stage. It was pointed out previously that this species has a simple type of conidiophore branching. In the species under study, the conidiophore branching is further simplified and the conidia are smaller (12–19 micra in diameter as against 21–28 × 15–18 micra in *S. dichanthicola*).

Sclerospora iseilematis was described by Thirumalachar and Narasimhan (1949) on the proliferating spikelets of *Iseilema laxum* Hack. Only oospores were observed, and they were very large, comparable in size with *Sclerophthora macrospora* (Sacc.) Thirum et al. (1953), and hence distinct from the species under study, though occurring on the same host species. The specific name *Sclerospora westonii* is proposed, named in honor of Dr. W. H. Weston, Farlow Herbarium, Harvard University, U.S.A., eminent mycologist and inspiring teacher, whose valuable contributions to the study of *Sclerospora* form the basis of our present knowledge of this group.



Figs. 1–7. Spores and sex organs of *Sclerospora westonii* sp. nov.—Fig. 1. Bulbous basal foot cell of conidiophore. × 750.—Figs. 2 and 3. Expanded, bifurcated and lobed secondary branches of conidiophores bearing numerous sterigmata. × 750.—Fig. 4. Spherical, subglobose or ovate conidia borne on sterigmata. × 1000.—Fig. 5. Germination of conidia. × 1250.—Fig. 6. Large, thick-walled, spherical oogonium with granular contents and with an antheridium adpressed to the oogonial wall. × 750.—Fig. 7. Oospore. × 1000.

Sclerospora westonii sp. nov.

Infection culmicolous, causing paling of color of leaves and proliferation of spikelets; conidiophores emerging out of stomata, 60–100 μ long, bearing single basal cells, 9–11.5 μ broad at the basal cell, 20–27 μ broad at the point of branching of the main axis. Branches, if present, dichotomous, 20–25 μ high, 12–15 μ in spread, usually with primary branches only, 2–4 in number, each bearing 2–3 obconical tapering sterigmata with conidia; rarely with main axis showing primary and secondary branches. Mature conidia globose-ovoid, hyaline, thin-walled, 12–19 μ in diameter, germinating by germ tubes.

Sex organs develop in the leaf and proliferating spikelets. Oogonia spherical, subglobose 40–50 μ in diameter, with granular contents. Oospores golden-brown, spherical, thick-walled, covered by the outer oogonial wall layer, 23–29 μ in diameter, wall 6–9 μ thick.

Habitat in leaves of *Iseilema laxum* Hack, Poona, India.

Infectio culmicola, producens pallescentiam foliorum et proliforationem spicularum; conidia evoluta ut rubigo in foliorum inferiore pagina; conidiophori emergentes e stomatibus, 60–100 μ longi, ornati singulis cellulis basalibus, 9–11.5 μ lati ad cellulam basalem, 20–27μ lati ad bifurcationem axis principis. Ramuli, si adsint, dichotomi, 20–25 μ alti, 12–15 μ patentes, vulgo ramulis primariis tantum ornati, 2–4 numero, quorum singuli supportant 2–3 sterigmata cum conidiis obconia et fastigata; raro axis princeps monstrat ramulos primarios et secundarios. Conidia matura globosa vel ovoidea, hyalina, tunuibus parietibus praedita, 12–19 μ diam., germ-inantia per poros germinationis. Organa sexualia evolutia in folio et in spiculis proliferantibus. Oogonium sphaericum, subglobosum 40–50 μ diam. contentis granularibus. Oosporae aureo-brunneae, sphaericae, crassis parietibus praeditae, opertae parietibus externis oogonii; magnit. 23–29 μ diam. parietibus 6–9 μ crassis.

Habitat in foliis *Iseilematis laxi* Hack. ad Poona in India.

In conclusion the authors wish to express their gratitude to Rev. Father Dr. H. Santapau, Ph.D., S. J. for kindly providing the Latin diagnosis.

PIMPRI
Poona, India.

Literature Cited

Safeeulla, K. M. and **M. J. Thirumalachar.** 1956. Periodicity factor in the production of asexual phase in *Sclerospora graminicola* and *Sclerospora sorghi* and the effect of moisture and temperature on the morphology of the sporangiophores. Phytopath. Zeit. **26**: 41–48.

Thirumalachar, M. J. and **M. J. Narasimhan.** 1949. Downy mildew on *Eleusine coracana* and *Iseilema laxum* in Mysore. Indian Phytopath. **2**: 46–51.

———— and ———— 1952. A new *Sclerospora* on *Dichanthium annulatum*. Phytopath. **42**: 596–598.

———— and **M. D. Whitehead.** 1952. Sporangial phase of *Sclerospora butleri*. Amer. Jour. Bot. **39**: 416–418.

BULLETIN OF THE TORREY BOTANICAL CLUB

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Studies in the genus *Nectria*—I. Factors influencing perithecial formation in culture[1]

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Hanlin, Richard T. (Ga. Exp. Sta., Experiment, Ga.) Studies in the genus *Nectria*. I. Factors influencing perithecial formation in culture. Bull. Torrey Bot. Club 88(2): 95–103. 1961.—Cultures of *Nectria gliocladioides* Smalley & Hansen, *N. peziza* Tode ex Fries, and *N. ipomoeae* Halsted were grown under different environmental conditions on both natural and synthetic media to determine some of the factors influencing perithecial production by these species in culture. Fruiting time in *N. gliocladioides* varied greatly, depending upon the medium. It was found that an increase in concentration of glucose, fructose or maltose gave increased numbers of perithecia and shorter fruiting time up to the 2.0% level; beyond this point fruiting decreased. Sucrose gave the same result, but only to the 1.0% level. Previous workers have found contrasting results for other Pyrenomycetes. Light was found to be necessary for fruiting in *N. gliocladioides* and *N. peziza*, but not in *N. ipomoeae*. Temperature also was important, with all three species fruiting best at 24°C. In *N. gliocladioides* and *N. ipomoeae* stromal formation was dependent upon nutrition, and all gradations from no stroma to an extension stroma could be found. This is evidence that this character is too variable and unreliable to serve as a criterion for the genus *Creonectria*.

One of the most difficult problems confronting the Ascomycete morphologist is that of obtaining adequate material for study. Field collections rarely provide critical early stages necessary to detailed studies. Perhaps the best approach is through growth of the fungus in laboratory culture, since this provides the investigator with ample material at any stage of development he may desire. Unfortunately however, the majority of the thousands of described species of Ascomycetes fail to produce mature ascocarps readily in culture. An attempt was made to shed light on this problem while carrying out studies on the ascocarp development of *Nectria gliocladioides* Smalley & Hansen, *N. peziza* Tode ex Fries, and *N. ipomoeae* Halsted. Several series of experiments were set up to determine some of the factors influencing perithecial production of these species in culture, with special attention being given to *N. gliocladioides*. The results of these experiments are reported here in the hope that the data may be applicable to other species as well.

Materials and Methods. *Nectria gliocladioides* was obtained as a single conidial isolate from Dr. E. B. Smalley. It was originally isolated from a decaying bulb of *Lilium auratum* Lindl. (Smalley & Hansen 1957). The

[1] Paper No. 1119, Department of Botany, The University of Michigan; and Paper No. 386, Journal Series, Georgia Experiment Station.

Portion of a dissertation submitted to the faculty of The University of Michigan in partial fulfillment of the requirements for the degree of Doctor of Philosophy. I am grateful to Dr. L. E. Wehmeyer for his guidance during this study and for reviewing the manuscript.

conidial stage is *Gliocladium roseum* (Link) Bainier; a *Verticillium* stage also occurs.

Nectria peziza was isolated from deer dung collected in Maine by Dr. L. E. Wehmeyer. Perithecia appeared after incubation in a damp chamber. No conidial stage was observed. As in other species of *Nectria*, isolation is made easier by the fact that the ascospores are extruded in the form of a cirrus. Nearly pure masses of ascospores can be picked up with a sterile needle and streaked on the surface of agar plates. Pure cultures can then be obtained by transferring germinating ascospores or hypal tips to fresh plates.

Nectria ipomoeae was obtained from the Late Dr. H. N. Hansen under the name *Hypomyces solani* Reinke & Berthold emend Snyder & Hansen. The conidial stage is *Fusarium javanicum* Koorders.

The media used in these experiments were divided into two groups: 1) synthetic media, i. e., those in which the exact chemical composition was known; and 2) natural media, which contained ingredients whose exact chemical composition was not known. The synthetic medium used consisted of a complete basal mineral medium, including trace elements. The one selected for use was essentially that utilized in work on *Neurospora* (Ryan 1950); the only modification was the deletion of the ammonium tartrate from the original formula. To this basal medium were added the various carbon sources tested.

Various natural media were also tested; among these were malt extract, wheat and hay (timothy) infusions, wheat germ, and oatmeal. These were prepared according to the general formulae of Ainsworth and Bisby (1954). Difco dehydrated preparations were used for corn meal and potato-dextrose agars (Difco Labs., Inc. 1953). Leonian's Nutrient Medium was prepared according to the original formula (Leonian 1924). In all instances a 2 per cent agar base was used.

No attempt was made to adjust the pH of the media used to a given level, and no pH changes were followed during growth. This could account for some of the differences obtained on different media or concentrations of nutrients.

All experiments, unles otherwise noted, were run in a 24°C constant temperature room under continuous flourescent ("Daylight") light at an intensity of 200 footcandles (± 25 footcandles). Temperature fluctuation was less than ± 2°C. Each series was run in triplicate. Inoculations were made by transferring conidia from stock cultures to test plates by means of a platinum loop, one loopful per plate. Agar-block transfers were avoided in order to eliminate the possibility of introducing unknown nutrients through the blocks. The length of time required for fruiting was taken as the first appearance of a perithecium containing mature ascospores (as determined by microscopic examination).

RESULTS

Growth Characteristics.—*Nectria gliocladioides.* When first obtained this species required over three months to produce mature perithecia on potato-dextrose agar. Since a shorter fruiting time was desirable for developmental studies, several experiments were set up in an attempt to shorten the time required for fruiting.

In all, some forty different media were tested. Colony diameter measurements were used at first for a comparison of the different media, but this proved inconclusive, since some growth was obtained even on a plain aqueous suspension of agar. Also, this technique did not take into account the total amount of mycelial growth. For this reason the length of time needed for the fungus to fruit on the different media was used as the basis for comparison. In plates having relatively few perithecia the actual number present was counted, but this proved impractical in most instances. On the best media hundreds of perithecia were produced in each plate.

In the first experiment it was noted that perithecia were never produced when the fungus was grown on plain agar (i.e., a suspension of Difco agar in distilled water) or plain agar plus the basal medium (i.e., no added carbon source), even when continued over a period of many months. Therefore, it was felt that the presence of perithecia could be attributed to substances added to the agar and basal medium, and that the effectiveness of

TABLE 1. *Fruiting time of* **Nectria gliocladioides** *on various synthetic media.*

Medium	Percentage concentration	Fruiting time in days[a]	Relative No. of perithecia[a, b]
Basal medium plus:			
Methyl cellulose	0.1%	19	++
Lignin	0.1%	19	+
Yeast extract	0.2%	90	+
Casein hydrolysate	0.1%	. . .	. . .
Ribose nucleic acid	0.1%	21	+
Glucose	0.2%	12	+
Glucose	1.0%	11	+++
Glucose	2.0%	11	++++
Glucose	4.0%	10	+++
Fructose	1.0%	15	++
Fructose	2.0%	15	+++
Galactose	0.2%	. . .	. . .
Galactose	1.0%	21	++
Galactose	2.0%	15	++
Sucrose	0.2%	35	++
Sucrose	1.0%	23	++
Sucrose	2.0%	. . .	. . .
Maltose	0.2%	. . .	. . .
Maltose	1.0%	50	+
Maltose	2.0%	35	++
Maltose	4.0%	. . .	. . .

[a] . . . = No perithecia after 120 days.
[b] + = Very few perithecia (less than 10 per plate); ++ = perithecia scattered (10–50 per plate);
+++ = perithecia numerous; ++++ = perithecia dense.

TABLE 2. *Fruiting time of* **Nectria gliocladioides** *on several natural media.*

Medium	Percentage concentration	Fruiting time in days[a]	Relative No. of perithecia[a]
Leonian's Medium		110	++
Wheat germ		11	++++
Corn meal		13	++
Hay infusion		13	+++
Potato-dextrose		100	++
Malt extract	0.2%	100	++
Malt extract	2.0%	19	++

[a] + = Very few perithecia (less than 10 per plate); ++ = perithecia scattered (10–50 per plate); +++ = perithecia numerous; ++++ = perithecia dense.

these substances in stimulating formation of perithecia could be compared with one another.

The time required for perithecia to form varied from ten to over one hundred days (tables 1 and 2). Distribution and abundance of perithecia also varied greatly, as summarized below:

1). As already noted, no perithecia formed on plain agar and plain agar plus basal medium. The same was true for basal medium with casein hydrolysate, 0.2 per cent galactose, 2.0 per cent sucrose, 0.2 per cent and 4.0 per cent maltose. Little mycelial growth occurred on these media.

2). Lignin, yeast extract, and ribose nucleic acid produced only sparse growth of aerial hyphae. Perithecia were only rarely formed, being limited to three or four per plate. They were not borne on stromata.

3). Methyl cellulose agar also gave little aerial growth of mycelium. Perithecia were formed singly, or in groups of two or three, scattered throughout the plate. No stromata were formed.

4). Malt extract, potato-dextrose, and Leonian's Nutrient Medium produced numerous small stromata scattered over the surface of the plate, each covered with a layer of perithecia.

5). The infusion agars (Wheat germ, hay, corn meal, oatmeal, etc.) produced in all instances a thick growth of mycelium with heavy conidial production. Perithecia formed on the surfaces of large stromata produced by the mycelium.

6). In general, the various sugars gave abundant growth and conidial production. Perithecia were formed in large numbers on extensive stromata; these stromata usually formed at the center of the plates. A concentration of 2.0 per cent glucose and fructose gave higher numbers of perithecia than did the others, while a concentration of 0.2 per cent sugar gave poorer results.

On all media tested both the *Gliocladium* phase and *Verticillium* phase (using the terminology of Hughes 1953) of the imperfect stage were present, with one exception. In general they both appeared at the same time, although the *Gliocladium* phase was sometimes noted first, especially on

richer media. The *Verticillium* conidiophores are shorter and less expansive than the *Gliocladium* conidiophores and are often obscured in the plate. When the fungus was grown on a lignin medium however, the *Verticillium* phase appeared first. It grew abundantly, and it was not until the culture was several weeks old that the *Gliocladium* phase appeared, and then it formed only a few scattered conidiophores.

Color variation on the different media was considerable, from light pink to dark salmon color, but it was always some shade of the basic orange color of the perithecium.

Nectria peziza. This species was originally isolated and grown on corn meal agar, on which it fruited in just over three weeks. The mycelium is slow-growing and does not produce extensive aerial hyphae. Perithecia are not nearly so abundant as in *N. gliocladioides;* so the fungus was grown on several other media to try to improve perithecial production. However, the fungus did not fruit well on other media (table 3). In fact, no growth occurred on basal medium plus 2.0 per cent glucose, which was the best medium for *N. gliocladiodes.* Therefore, corn meal agar continued to be used for growth of this fungus. No stroma was observed in this species.

Nectria ipomoeae. In contrast to *N. peziza, N. ipomoeae* grew and fruited so well in culture that extensive testing of different media was not necessary. The fungus grew rapidly and produced extensive aerial hyphae. The result of the few tests made are seen in table 3. When grown on

TABLE 3. *Fruiting time of* **Nectria peziza** *and* **N. ipomoeae** *on several media.*

Medium	Percentage concentration	Fruiting time in days[a] N. peziza	N. ipomoeae	Relative No. of perithecia[a,b] N. peziza	N. ipomoeae
Leonian's Medium		. . .	24	. . .	++
Wheat germ		. . .	10	. . .	++++
Corn meal		24	45	++	+++
Malt extract	2.0	. . .	24	. . .	++
Basal Medium plus:					
Glucose	2.0	no growth	35	. . .	++
Maltose	2.0	no growth	65	. . .	++

[a] . . . = No perithecia after 110 days.
[b] + = Very few perithecia (less than 10 per plate); ++ = perithecia scattered (10–50 per plate); +++ = perithecia numerous; ++++ = perithecia dense.

basal medium plus 2.0 per cent maltose and basal medium plus 2.0 per cent glucose, the perithecia were borne on a stroma; on the remaining media they were formed free in the aerial mycelium.

Effects of Temperature.—*Nectria gliocladioides.* To check the effect of temperature on fruiting time, plates were placed under constant temperatures of 6° C, 17° C, 24° C, and 33° C. Cultures were kept under continuous light and were grown on basal medium plus 2.0 per cent glucose.

Fruiting was most rapid at 24° C (table 4), while at temperatures

TABLE 4. *Effect of temperature on fruiting time of* **Nectria gliocladioides, N. peziza,** *and* **N. ipomoeae.**

Fungus	Fruiting time in days at			
	6°C	17°C	24°C	33°C[a]
Nectria gliocladioides				
2.0% glucose	. . .	16	11	30
4.0% glucose	. . .	30	10	. . .
Nectria peziza	. . .	24	28	. . .
Nectria ipomoeae	. . .	12	9	. . .

[a] . . . = No fruiting after 40 days.

both above and below this longer times were required. The total number of perithecia was also considerably less at these temperatures.

The temperature effect also seemed to vary with change in sugar concentration. This species required nearly twice as long to fruit on a medium containing 4.0 per cent glucose at 17° C as it did when the medium contained 2.0 per cent glucose. This variation was not apparent at 24° C, however, and at 33° C no perithecia formed on 4.0 per cent glucose.

Nectria peziza. An experiment similar to that above was run on this species. Cultures were grown on corn meal agar. The results can be seen in table 4. No growth of mycelium took place at 33° C, while at 6° C the fungus grew reasonably well but did not fruit.

Nectria ipomoeae. A third experiment was set up to check temperature effects on this species, as seen in table 4. Cultures were grown on wheat germ agar.

As in the other species, fruiting was best at 24° C, with no positive results being obtained at 6° C and 33° C. The mycelium grew well at all temperatures, but was slowest at 6° C.

Effects of Light.—*Nectria gliocladioides.* Experiments were conducted to determine the effect of light on fruiting. Cultures were inoculated on eighteen 2.0 % glucose-basal medium plates and immediately placed in a series of light-tight containers. This permitted some plates to be examined without exposing the remaining ones to light. The containers were then placed in the 24° C light room alongside of another series of control plates on the same medium run concurrently in the light.

As usual, the plates in the light formed mature perithecia after eleven days. Those kept in the dark grew well and formed stromata, but no perithecia were produced. Some plates remained in total darkness for sixty days without fruiting. After exposure to light, however, these same cultures formed perithecia within ten days. In sections made of forty-day old plates kept in total darkness perithecial development was found to be arrested at an early stage, just after the first enveloping hyphae had surrounded the young archicarp.

Another effect of light was on pigment formation. Cultures grown in darkness have hyaline stromata and conidia, in contrast to the orange color of cultures grown in light. When these colorless plates were exposed to light pigmentation developed but never seemed to become as intense as in plates grown in light.

Nectria peziza. This experiment was run on corn meal agar at 24° C. The mycelium grew normally in the dark, but did not form perithecia after ninety days. However, after subsequent exposure to light, these same plates showed young perithecia within six days.

Nectria ipomoeae. This fungus was grown on wheat germ agar at 24° C. Perithecia formed normally in cultures kept in constant darkness, although not as abundantly as in plates grown in light. The aerial hyphae were more compact in dark grown cultures, but otherwise the colonies appeared the same.

Discussion. The reviews on carbohydrate nutrition of fungi by Hawker (1950, 1957), Lilly and Barnett (1951), and Cochrane (1958) contain surprisingly little information on the effects of carbohydrates on the fruiting of pyrenomycetous fungi. The information contained in these works is based mainly on studies by Hawker (1939, 1947), Hawker and Chaudhuri (1946), and Bretzloff (1954), which support the idea originally proposed by Klebs (1899) that sexual reproduction in fungi is greatest under conditions of reduced nutrition. This idea gained wide acceptance and is generally thought to be true for most fungi.

Hawker (1939), working with *Melanospora destruens* (Shear) Shear and Dodge (= *Sordaria destruens* (Shear) Hawker (Hawker 1951)), found that in general an increase in sugar concentration resulted in decreased fruiting. Glucose, fructose, maltose and sucrose all showed the same general pattern, although the optimum concentration varied for the different sugars. In 1946 Hawker and Chaudhuri conducted similar studies on the Pyrenomycetes *Podospora* sp., *Sordaria fimicola*, *Melanospora zamiae*, *Chaetomium cochliodes* and *Ceratostomella adiposa*. Again they found that an increase in sugar concentration resulted in a decrease in numbers of perithecia produced, although the optimum concentration varied for the different species. Then in 1954 Bretzloff reported that *Sordaria fimicola* fruited sooner and more abundantly under low carbohydrate conditions in which vegetative growth was limited.

Leonian (1921) reported somewhat different results with *Valsa leucostoma*. When grown on oatmeal agar this fungus would fruit only when sucrose was added. On corn meal agar, however, the opposite was true; the addition of sucrose inhibited perithecial formation, which occurred readily on the plain medium. In his later, more comprehensive study of this fungus, Leonian (1923) found that a general reduction in nutrients

resulted in decreased reproduction. He also noted that an increase in sugar concentration did not result in increased fruiting, which was essentially the same at all levels. However, all cultures were initially grown on a nutrient solution containing 0.6 per cent maltose before being transferred to the sugar solution under investigation. Since this level of maltose produced numbers of perithecia equal to that of any of the other sugars used, it is conceivable that this could have influenced perithecial production at the lower levels of glucose and fructose.

It is apparent that *Nectria gliocladioides* differs in some respects in its requirements from other Pyrenomycetes studied so far. An increase in the concentration of glucose, fructose, or maltose gave a corresponding increase in both the number of perithecia produced and the speed with which they formed, up to the 2.0 per cent level. Sucrose gave the same result, but only to the 1.0 per cent level. Exceeding these levels resulted in reduced numbers of perithecia. Conditions of relatively high nutrition, therefore, were most favorable for perithecial formation as well as for mycelial growth and conidial production, the opposite of what has been found for most other species studied and is often assumed to be true for most fungi. Only further studies can determine the requirements for sexual reproduction for each species of Ascomycete, but it may be that a relatively high-carbohydrate requirement is more common than is generally believed.

Another point of interest brought out in this study is the variability in stromal formation in *N. gliocladioides*. Depending upon the medium used, gradations from no stroma to extensive stromata could be obtained. In general, the largest stromata formed on those media highest in nutrition (e.g., glucose and wheat germ), while on some media (e.g., cellulose) no stromata formed. On other media, such as potato-dextrose and malt extract, stromata intermediate in size formed. However, it was possible to find on any medium separate perithecia which were not borne on a basal stroma. This is in accord with Smalley and Hansen's (1957) original description of this species as "borne densely clustered on fleshy yellow stromata or scattered without stromata". *N. ipomoeae* showed this same general variation, although the differences in size of stromata were not so pronounced.

This is an important observation in view of Seaver's (1909a, 1909b) division of the genus *Nectria* on the presence or absence of a stroma. Stromatic members of the genus were placed in his new genus *Creonectria*, with non-stromatic species being retained in *Nectria*. Under this system specimens grown during this study could be placed in either the genus *Nectria* or *Creonectria*, depending upon the medium used. Since the presence or absence of a stroma can be correlated with the level of nutrition of the substrate, it seems that this is too variable a character to serve as a generic criterion. With the variety of substrata available to the fungus in the field it is entirely conceivable that both stromatic and non-stromatic

forms could be found. Substrata high in sugars (or hydrolyzed starch) would produce stromata as in *Creonectria*, whereas cellulose substrata might give non-stromatic forms, as in *Nectria*. This is obviously as unnatural and undesirable arrangement. If other species of *Creonectria*, especially the type species *C. purpurea* (L.) Seaver (= *Nectria cinnabarina* Tode ex Fries), are shown to exhibit the same variability, there would then be sufficient morphological evidence that the stroma as a taxonomic character is unreliable, and that the genus *Creonectria* as based on this character cannot be maintained.

Literature Cited

Ainsworth, G. C. and **G. R. Bisby.** 1954. A dictionary of the fungi. The Commonwealth Mycol. Inst. Kew, Surrey, England.

Bretzloff, C. W. Jr. 1954. The growth and fruiting of *Sordaria fimicola*. Am. Jour. Bot. **41**: 58–67.

Cochrane, V. W. 1958. Physiology of Fungi. John Wiley & Sons, Inc. New York.

Difco Labs., Inc. 1953. Difco manual of dehydrated culture media and reagents for microbiological and clinical laboratory procedures. Detroit.

Hawker, L. E. 1939. The influence of various sources of carbon on the formation of perithecia by *Melanospora destruens* Shear in the presence of accessory growth factors. Ann. Bot. II **3**: 455–468.

———— 1947. Further experiments on growth and fruiting of *Melanospora destruens* Shear in the presence of various carbohydrates, with special reference to the effects of glucose and of sucrose. Ann. Bot. II. **11**: 245–260.

———— 1950. Physiology of Fungi. Univ. of London Press, Ltd. London.

———— 1951. Morphological and physiological studies on *Sordaria destruens* (Shear) comb. nov. (Syn. *Melanospora destruens*), *Sordaria fimicola* and *Melanospora zamiae*. Brit. Mycol. Soc Trans. **34**: 174–186.

———— 1957. The Physiology of Reproduction in Fungi. Cambridge Univ. Press. Cambridge.

———— , and **S. D. Chaudhuri.** 1946. Growth and fruiting of certain ascomycetous fungi as influenced by nature and concentration of carbohydrates in the medium. Ann. Bot. II. **10**: 185–194.

Hughes, S. J. 1953. Conidiophores, conidia, and classification. Can. Jour. Bot. **31**: 577–659.

Klebs, G. 1899. Zur Physiologie der Fortpflanzung einiger Pilze. II. Jahrb. Wiss. Bot. **33**: 71–151. For English review see Bot. Gaz. 28: 441.

Leonian, L. H. 1921. Studies on the *Valsa* apple canker in New Mexico. Phytopathology 11: 236–243.

———— 1923. The physiology of perithecial and pycnidial formation in *Valsa leucostoma*. Phytopathology **13**: 257–272.

———— . 1924. A study of factors promoting pycnidium-formation in some Sphaeropsidales. Am. Jour. Bot. **11**: 19–50.

Lilly, V. G. and **H. L. Barnett.** 1951. Physiology of Fungi. McGraw-Hill Book Co., Inc. New York.

Ryan, Francis, J. 1950. Selected methods of Neurospora genetics, *In* Methods in Medical Research, vol. 3. Edited by Ralph W. Gerard. The Year Book Pub., Inc. Chicago.

Seaver, F. J. 1909a. The Hypocreales of North America-I. Mycologia **1**: 41–76.

———— . 1909b. The Hypocreales of North America-II. Mycologia **1**: 177–207.

Smalley, E. B. and **H. N. Hansen.** 1957. The perfect stage of *Gliocladium roseum*. Mycologia **49**: 529–533.

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A NOTE ON THE LONGEVITY OF SEED OF *Lagenaria siceraria* (Mol.) Standl. AFTER FLOATING IN SEA WATER

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ABSTRACT

WHITAKER, T. W. and G. F. CARTER. (USDA, La Jolla Cal. and The Johns Hopkins U.) A note on the longevity of seed of *Lagenaria siceraria* (Mol.) Standl. after floating in sea water. Bull Torrey Bot. Club 88(1): 104–106. 1961.—Following up, after 6 years, emergence tests on gourds soaked in sea water for varying periods, it was shown that there is no correlation between present viability and length of immersion, or the original percent emergence and retention of viability. While remaining viable under various conditions to permit dispersal and germination in favorable niches, other evidence suggests a recent introduction to the Americas and cautions against the theory of introduction by oceanic drift.

In 1953 the authors completed experimental work indicating that mature, intact fruits of *Lagenaria siceraria* would float in sea water up to 347 days without damage to emergence of the seed within the gourds (Whitaker and Carter, 1954, and unpublished data). After taking a sample of 100 seeds for the emergence tests, the gourds containing the remaining seeds were stored in an unused corner of a greenhouse. Conditions were not ideal for seed storage; the maximum relative humidity was about 80 percent, and temperatures ranged from about 50°F to 100°F.

During February, 1960, the emergence tests were repeated using 50 seeds from each gourd. Of the original 24 gourds in the experiment, 18 (75%) contained 50 seeds for testing in 1960. The seeds were planted in flats in ordinary garden soil. The seedlings that emerged were vigorous and healthy; no morphological abnormalities were apparent.

RESULTS

The results of the 1960 emergence tests are recorded in table 1, along with pertinent data, and the original percentages of emergence for comparison. Of seed from 18 gourds tested, 7 (about 40%) contained seed that emerged with values from 14 to 32 percent. Seed of the remaining 11 gourds was completely inviable.

At least three conclusions are suggested from a study of table 1.

1. The number of days afloat evidently has no relation to the percentage of emergence because a gourd floated for 347 days had seed with an emergence value of 24 percent compared with the slightly greater value of 32 percent for the control. In general, there seems to be no correlation between present viability and the length of time the gourds were immersed in sea water 6

TABLE 1. *Seed emergence tests of gourds floated for various lengths of time in sea water and stored for approximately 6 years. Fifty seeds were tested from each gourd.*

Gourd no.	Days afloat	Date planted	Date scored	No. seeds emerged	% 1960 emergence	% 1953 emergence
Controls	—	2/ 6/60	3/10/60	16	32	71–100
5	28	3/28/60	4/18/60	12	24	80
2A	56	2/ 6/60	3/10/60	none	—	88
7A	56	3/28/60	4/18/60	none	—	81
3A	85	2/ 6/60	3/10/60	none	—	87
7	85	3/28/60	4/18/60	7	14	90
5A	140	3/28/60	4/18/60	16	32	95
3	140	2/ 6/60	3/10/60	16	32	65
8A	168	3/28/60	4/18/60	none	—	92
9A	168	3/28/60	4/18/60	none	—	59
9	196	3/28/60	4/18/60	none	—	43
6A	196	3/28/60	4/18/60	none	—	77
6	224	3/28/60	4/18/60	none	—	93
2	252	2/ 6/60	3/10/60	none	—	87
12	280	3/28/60	4/18/60	16	32	85
4A	315	3/28/60	4/18/60	12	24	95
12A	315	3/28/60	4/18/60	none	—	91
8	347	3/28/60	4/18/60	none	—	75
1A	347	2/ 6/60	3/10/60	12	24	57

years ago.

2. There is no apparent relation between the original percent emergence and retention of viability over a period of six years. Several gourds with comparatively low percentage of emergence in the original tests retained the power to emerge after the storage period equally as well as those that were originally high in emergence.

3. Longevity of the seed evidently depends upon a number of genetic and environmental factors. The length of time the gourd was immersed in sea water is only one of the environmental factors and it is not decisive.

DISCUSSION

These recent tests of viability of seeds from gourds floated for various periods of time in sea water and stored for six years show that *Lagenaria siceraria* could have been distributed from continent to continent by oceanic drift. It is also clear that if such gourds were cast ashore, the seed would remain viable long enough to allow ample opportunity for its dispersal into favorable niches for germination and growth. This does not prove, however, that gourds reached America by oceanic drift.

Seed-bearing gourds could well have been brought to the Americas by early boat cultures on accidental or purposeful voyages. Gourds were in use on both sides of the Pacific in pre-historic time (Eames and St. John, 1943; Whitaker and Bird, 1949). *Lagenaria* is not reported to be a strand plant. If picked up on a strand it would have to be carried inland for planting either by animals or humans.

A gourd float discarded in a village site could be expected to have viable seeds and a village site would be an excellent ecological niche for the plant.

The data reported here would then fit either a natural drift, or some form of cultural carriage. A natural introduction is indicated if the time of appearance of the gourd in America is geologically old. Cultural introduction is suggested if the time of introduction falls within the time space that man is known to have been going to sea in craft capable of surviving oceanic voyages. In view of the record of early, bronze age voyaging in the Atlantic, and the great antiquity of sailing-centerboard rafts in the Pacific, it may be difficult to obtain clear cut evidence bearing on this problem.

We are left then with these questions. Is the gourd geologically old in America or does it appear here only in times so recent as to suggest human introduction? Present evidence suggests it is recent. We know *Lagenaria siceraria* only from archeological remains and it has never been collected as a truly wild plant. These two facts support the notion that it is a relatively recent introduction. What is the source of the idea of using the gourd in particular ways? Such parallels as use of gourds for net floats, and as a head mask for catching ducks strongly suggest spread of ideas about ways of using gourds. This cautions against concluding that because gourds are capable of floating to the Americas from other continents, it is proof they really did.

LITERATURE CITED

Eames, A. J. and H. St. John. 1943. The botanical identity of the Hawaiian ipu nui or large gourd. Amer. Jour. Bot. 30: 255–259.

Whitaker, T. W. and J. B. Bird. 1949. Identification and significance of the cucurbit materials from Huaca Prieta, Peru. Amer. Museum Novitates, 1426, 15 pp.

———— **and G. F. Carter.** 1954. Oceanic drift of gourds—experimental observations. Amer. Jour. Bot. 41: 697–700.

Electron microscope observations on *Gloeocapsa* sp.

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Abstract

SUN, C. N. (Washington U., St. Louis) Electron microscope observations on *Gloeocapsa sp.* Bull. Torrey Club 88(2): 106–110. Illus. 1961.—The cell membrane of *Gloeocapsa* was found to be about 280 Å thick. No nuclear membrane and no boundary line between the so-called "chromoplasm" and "centroplasm" could be distinguished. Lamellae occur in the peripheral cytoplasm. The distance between two adjacent lamellae is 440 Å. The thickness of each lamella is 250 Å. It is suggested that these lamellae serve the same function as the lamellar system in the chloroplasts of higher plants. The most conspicuous inclusions in the peripheral cytoplasm are granules which seem to be cyanophycin granules. Along with these occur many vacuoles which appear to result from the digestion of the granules. Osmiophilic granules, about 0.1–0.3 microns in diameter, also occur in the cytoplasm. These are similar to the osmiophilic globules occurring in the chloroplasts of higher plants. No typical mitochondria with internal folds occur.

The low level of cellular differentiation of the Cyanophyceae has long interested plant scientists. Numerous investigations with the light microscope have failed to find clear-cut evidence of organized nuclei or definite plastids. Earlier workers, accordingly, concluded that the chlorophyll must be equally diffused throughout the cytoplasm.

More recently, however, electron microscope studies by Niklowitz and Drews (1956) and by Fuhs (1958) showed that the cells of certain other blue-green algae do have in their cytoplasm a laminated structure within which the chlorophyll is located. Since all chloroplasts studied to date consist of systems of laminae (Granick, 1955, Leyon 1956, Mühlethaler 1955, Wettstein 1957), the laminated structure reported in the cells of the blue-green algae appeared to be particularly significant. It therefore seemed of interest to investigate *Gloeocapsa* sp. for similar cholorophyll-bearing structures.

MATERIALS and METHODS. The specimens used for this investigation were obtained from the Algae Culture Laboratory of Indiana University, through the courtesy of Dr. R. C. Starr. The number of the specimen is LB 795, *Gloeocapsa* sp. which was isolated by Markle.

The specimens, suspended in their culture medium, were first centrifuged to the bottom of test tubes; the supernatant culture medium was then discarded, and the plants fixed in Dalton's osmium tetroxide-bichromate mixture at pH 7.6 for four hours. Next, they were dehydrated, centrifugation being employed with each change of solution. When completely dehydrated, 1 per cent phosphotungstic acid in absolute ethyl alcohol was applied for 2 hours. Finally, the specimens were embedded in a 6:1 n-butyl and methyl methacrylate mixture, following the general procedure for plant tissues (Sun, 1960). Sections were cut with a Porter Blum microtome, and examined under an RCA EMU-2 electron microscope.

OBSERVATIONS and DISCUSSION. The electron photo-micrographs show the gelatinous sheath to be a relatively thick layer with a fine fibrillar texture (fig. 5). The sheath appears homogeneous but variable in thickness. The inner surface is in contact with a distinct cell membrane about 280 Å thick (fig. 1, 4M). Earlier workers (Schmitz 1879, Drawert 1949) usually distinguished between a peripheral portion of the cell which they called "chromoplasm" and a central zone known as "centroplasm". The electron photo-micrographs, however, show no boundary betwen these zones. In the central area of the cell there are some irregular light profiles each with a small dense granule or thread (fig. 2N). Because this material is similar with the nuclear material of bacteria (Chapman and Hillier 1953, Chapman 1959), and since this form has no nucleus, the irregular profiles may represent nuclear material in *Gloeocapsa*. There are lamellae in the cytoplasm, especially in the peripheral portions of the cell (fig. 3, 5L). The

lamellae occur in bundles around the central zone of the cell (fig. 4L). Each bundle has 4–12 lamellae. The distance between two adjacent lamellae is 440 Å. The thickness of each lamella is 250 Å.

The present study has demonstrated the lamellar structure in *Gloeocapsa*, an additional genus of Cynophyceae. Since chlorophyll has always been shown to be localized on a lamellar structure in the chloroplasts, it may well be that the cholorophyll in the blue-green algae is located on similar structures, i.e., on the lamellar system described here in the cytoplasm. The recent evidence of energy transfer between pigment molecules in photosynthesis may provide support for this view. Thus, light absorbed by phycocyanin and phycoerythrin in the blue-green and red algae is transferred to chlorophyll (Blinks 1954). The energy transfer system implied by these findings, requires close and precise disposition of pigment molecules in a continuous solid phase, such as a membrane or lamella, through which energy transmission could occur. This point has been mentioned by Sager and Palade (1957).

The dimensions of the lamellar structure of *Gloeocapsa* differ somewhat from the thickness of grana-lamellae in the chloroplasts of higher plants, e.g., in the *Aspistra* chloroplasts in which each grana-lamella is about 60–80 Å (Leyon 1956, Steinmann and Sjöstrand 1955) and in *Psilotum* chloroplasts in which each grana-lamella is about 80 Å (Sun 1961). In *Gloeocapsa*, by contrast, each lamella is about 250 Å, which is of an unusual thickness. The occasional reports that these plants contain grana (Calvin and Lynch 1952) or chloroplasts (Elbers, Minnaert and Thomas 1957) were not confirmed by the present study. There is indeed a lamellar structure in the cytoplasm, but the lamellae are not surrounded by an outer membrane to form a chloroplast. No free grana were ever observed.

In the electron photo-micrographs, granules of 0.3–0.9 microns in diameter stain deeply in the peripheral cytoplasm (fig. 1–3 CG). These granules are similar to the cyanophycin granules occurring in the blue-green algae (Fritsch 1952). In fig. 1, 5P some granules are seen with irregular borders. There are many vacuoles interspersed between the above described granules (fig. 1–5V). It is known that cyanophycin granules are protein reserves and are digested with only vacuoles (pseudo-vacuoles) remaining (Canabaeus 1929). It is tempting to look upon the deeply-staining granules described above as cyanophycin granules, those with irregular borders as partially digested cyanophycin granules and the above described vacuoles as the pseudo-vacuoles which remain after complete digestion.

Typical mitochondria with internal membranes have not been found in blue-green algae. Osmiophilic globules were present generally in the cytoplasm. In *Gloeocapsa*, the osmiophilic granules are about 0.1–0.3 microns in diameter (fig. 1, 3, 4O). Niklowitz and Drews (1956) called them mito-

chondria because they stained with Janus Green B. However, they appear more like the osmiophilic globules in the chloroplasts of higher plants than like mitochondria.

Literature Cited

Blinks, L. R. 1954. The role of accessory pigments in photosynthesis, in autotrophic microörganisms. Cambridge University Press.

Calvin, M. and **V. Lynch.** 1952. Grana-like structure of *Synechococcus cedorum*. Nature **169**: 455.

Canabaeus, L. 1929. Ueber die Heterocysten und Gasvakuolen der Blaualgen und ihre Beziehungen zu einander. Pflanzenforschung **13**: 1–48.

Chapman, G. B. 1959. Electron microscopy of ultrathin sections of bacteria. III. Cell wall, cytoplasmic membrane and nuclear material. Jour. Bacteriol. **78**: 96–604.

————, and **J. Hiller.** 1953. Electron microscopy of ultrathin sections of bacteria. I. Cellular division in *Bacillus cereus*. Jour. Bacteriol. **66**: 362–373.

Drawert, H. 1949. Zellmorphologische und zellphysiologische Studien an Cyanophyceen. Planta. **37**: 161–209.

Elbers, P. F., K. Minnaert, and **J. B. Thomas.** 1957. Submicroscopic structure of some chloroplasts. Acta Botanica Neerl. **6**: 345–350.

Fritsch, F. E. 1956. The structure and reproduction of the algae. v. 2. Cambridge University Press.

Fuhs, G. W. 1958. Untersuchungen an Ultradünnschnitten von *Oscillatoria amoena* (Kütz) Gomont. Protoplasma **49**: 521–540.

Granick, S. 1955. Plastid structure, development and inheritance. Handbuch der Pflanzenphysiologie. **1**: 507–564. Springer, Berlin.

Leyon, H. 1956. The structure of chloroplasts. Sv. Kem. Tidskr. **68**: 70–89.

Mühlethaler, K. 1955. The structure of chloroplasts. Internat. Rev. Cytol. **4**: 197–220.

Niklowitz, W. and **G. Drews.** 1956. Beitrage zur Cytologie der Blaualgen. Arch. Mikrobiologie **24**: 134–146, 147–162.

Sager, R. and **G. E. Palade.** 1957. Structure and development of the chloroplasts in *Chlamydomonas* 1. The normal green cell. Jour. Biophys. Biochem. Cytol. **3**: 463–488.

Schmitz, F. 1879. Untersuchungen uber die Zellkerne der Thallophyten. Sitz-ber. Niederrhein. Ges. Nat. u. Heilk. Bonn. 345–376.

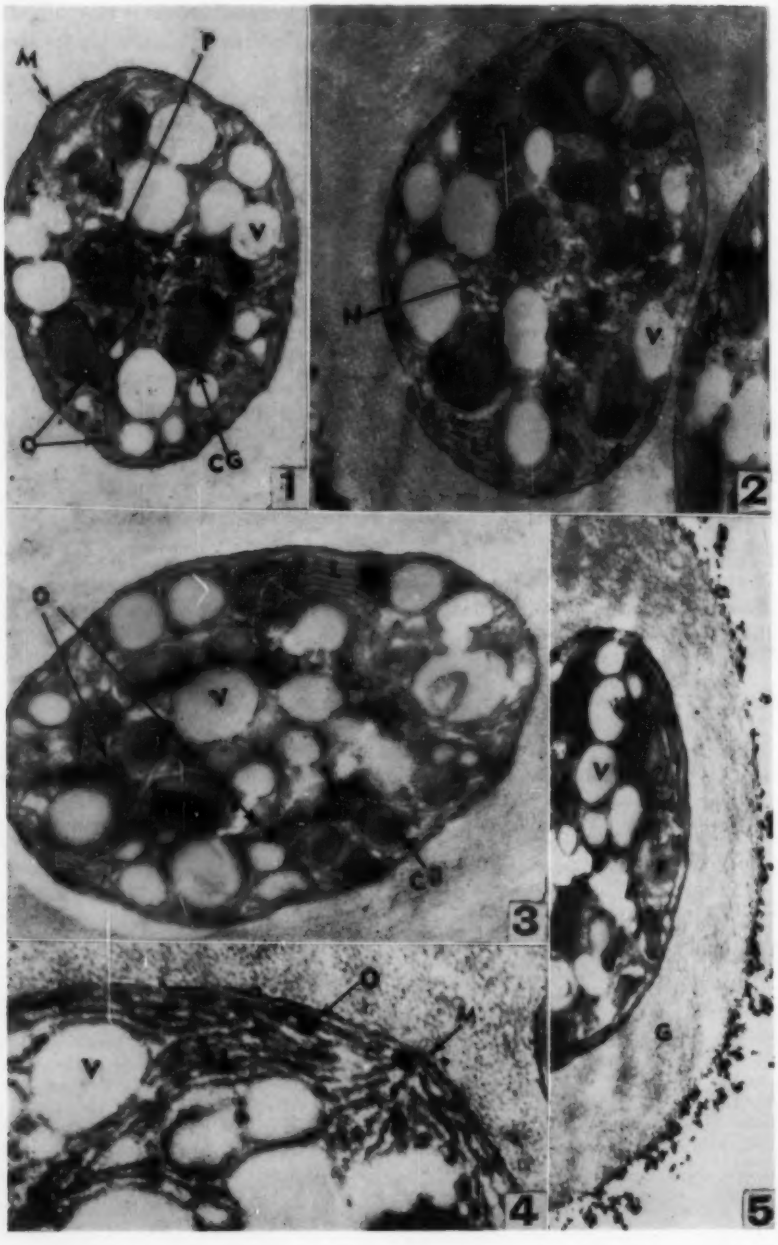
Steinmann, E. and **F. S. Sjöstrand.** 1955. The Ultrastructure of Chloroplasts. Expt. Cell Res. **8**: 15–23.

Sun, C. N. 1960. A demonstration by electron microscope of plasmodesmata in the embryonic leaf cell walls of *Cibotium chamissoil*. Bull. Torrey Bot. Club. **87**: 337–341.

————, 1961. Submicroscopic structure and development of the chloroplasts of *Psilotum triquetnum*. Amer. Jour. Bot. **48**: 311–315.

Wettstein, D. von. 1957. Chlorophyll Latale und der submikroskopische Formwechsel der Plastiden. Exp. Cell Res. **12**: 427–506.

Fig. 1–5. Electron photomicrographs of sections of *Gloeocapsa* sp. Magnification: figs. 1 and 2. 16,000 ×; fig. 3. 21,000 ×; fig. 4. 40,000 ×; fig. 5. 14,000 ×. CG, cyanophycin granule; P, partially digested cyanophycin granules; G, fine fibrillar texture of gelatinous sheath; L, lamellae in the cytoplasm; M, cell membrane; N, nuclear material; O, osmiophilic granule; V, vacuole.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TORREYA

BERNARD OGILVIE DODGE

WILLIAM J. ROBBINS

Bernard Ogilvie Dodge was born April 18, 1872 on his father's farm near Mauston, Wisconsin. He died at the age of 88 on August 9, 1960 in St. Luke's Hospital, New York City.

His ancestors were old New England stock, mainly of English origin. They were hard-working farmers, blacksmiths, tanners, wheelwrights, who paid their debts, avoided law suits, had enough means to insure for themselves and their families a decent burial and to pass on to their heirs something material, as well as a good name. There were no plutocrats and no paupers—no great scholars, divines, physicians or lawyers.

His paternal grandfather, Levi Dodge, was descended from Richard Dodge, who came from Somersetshire, England to Salem Massachusetts in 1638. The Dodges lived in Massachusetts until they moved to New Hampshire in 1799 and to Vermont in 1833. Dr. Dodge's father settled in Wisconsin in 1856. It is worth recording that there were in Dr. Dodge's direct line five successive Richard Dodges, and that his great-great-grandfather (Richard Dodge No. 5) and five brothers were privates in the American Revolution.

His paternal grandmother, Olive (Blanchard) Dodge, was the granddaughter of John Blanchard, born in Connecticut in 1737. The ancestry of John Blanchard is uncertain; he may have descended from Thomas Blanchard, William Blanchard or the widow Blancher [Blanchard], all of whom were in Massachusetts between 1637 and 1639.

It is said that Olive (Blanchard) Dodge was accustomed in her old age to sit on her porch, rocking back and forth in time with the lively tunes she whistled with considerable skill, although she had long since lost all her teeth. Dr. Dodge, too, was an inveterate whistler, a habit he was inclined to assign to the genes from his grandmother who died when he was two years old.

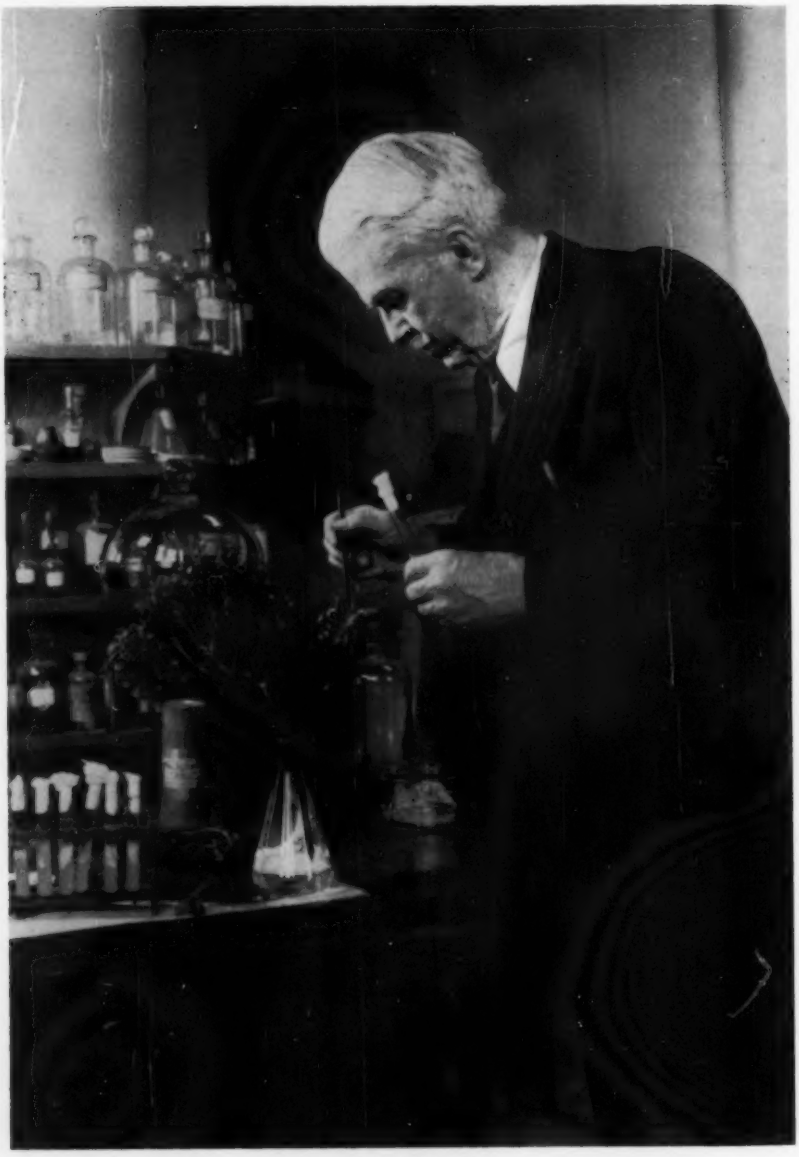
Bernard Ogilvie Dodge, April 18, 1872—August 9, 1960

Dr. Dodge's maternal grandmother, Mary Ann (Rogers) Nourse, was descended from Robert Rogers who came from England to The Massachusetts Bay Colony in 1634. The Rogers family remained in Massachusetts for five generations until Mary Ann's father, Micajah Rogers, moved to New Hampshire in the 1790's and from there to Vermont. Mary Ann and her husband, William Nourse, went to Wisconsin in 1856.

Dr. Dodge's maternal grandfather, William Nourse, was a lineal descendant of Francis Nourse, who came from England and was in Salem, Massachusetts in 1639. His wife, Rebecca (Towne) Nourse, had come to The Massachusetts Bay Colony from Great Yarmouth, England, about 1638. Francis and his wife prospered and became one of the most highly honored and respected couples in the community. Rebecca bore her husband nine children and is reported to have been "a model of every virtue." In part, because of their prosperity and popularity, jealousies were aroused and in the hysteria which swept Salem in 1692 Rebecca Nourse was accused of witchcraft. On July 19, 1692, at the age of 71, she was hanged on Gallows Hill. The Salem witchcraft madness soon passed away and today Rebecca's old home is a shrine. A granite monument in her memory stands in the Nourse cemetery nearby.

In spite of this tragedy, the Nourses remained in Massachusetts (they left Salem, a natural reaction under the circumstances) until Rebecca's great grandson, Nathaniel, moved to New Hampshire in 1779, and his grandson, William (grandfather of B. O. Dodge) travelled on to Vermont in 1830 and to Wisconsin in 1856.

Dr. Dodge's mother, Mary Ann (Nourse) Dodge and father, Eldridge Gerry Dodge, were unusual people. His father was a carpenter, a trade he followed along with teaching and farming until he was 39, but his real interests were in music, literature



Bernard Ogilvie Dodge.

and school teaching. He began his career as a school teacher in Vermont where at the age of 18 he taught in the district school, one term of three months at $8.00 per month; a second year brought $10.00 per month, and by the third year his compensation had risen to $12.00 per month. Since he was under 21 all this income was turned over to his father—a custom which, I believe, has long disappeared along with $8, $10, and $12. per month teachers.

Eldridge Gerry Dodge left Vermont in 1853 and after periods in Ohio, Minnesota and Wisconsin, settled near Mauston, Wisconsin in 1858 where he married Mary Ann Nourse in 1861. Save for a period of service in the Northern Army during the Civil War, he devoted the rest of his active life to farming, to teaching in the district schools, and to his family. A vegetable and fruit garden, an apple orchard and a mill for making sorghum syrup, plus some cash from teaching, gave him and his family their living.

A man with no high school or college education, he had a great interest in and a wide acquaintance with the writings of Shakespeare, Byron, Chaucer, Spencer, Pope, Dryden, Tennyson and others, and would recite entire scenes from Shakespeare to his attentive family. At the same time he enjoyed reading about Peck's Bad Boy or Josiah Allen at Saratoga, and on one occasion Dr. Dodge remembered, called his sons from the fields to hear him read dramatically an account of the Sullivan-Kilrain prize fight.

Dr. Dodge's mother, Mary Ann (Nourse) Dodge, was sixteen when she accompanied her family from Vermont to Wisconsin in 1856. She taught school until she married Eldridge Gerry Dodge before a Justice of the Peace in 1861, in spite of the strong disapproval of her father. I wish I had time to describe for you the wedding night of the young couple disbarred in the rain from the Nourse family home and forced to take refuge with sympathetic neighbors until their own home could be completed far enough to be lived in. Mary Ann Dodge bore her husband five sons and two daughters and lived the life of a pioneer's wife. But Dr. Dodge thought of her as a poet and an artist who saw beauty in the common labor of the day, inspired in her children a love for music and was able to express herself in rhyme, though she had never had more schooling than that provided by a district school. At sixty-nine she undertook the translation of a 64-page Spanish story into English.

His mother and father were happy in their family life and though limited in their formal education were inspired by a love of music, literature and learning—a circumstance which must have had much to do with molding the attitudes and determining the ambitions of their children.

The daughters married; one died at the age of 33, the other lived to be 83. Of the five sons, one graduated from Rush Medical School and practiced medicine at Franklin Park near Chicago for more than 40 years; one became a musician and band leader; one with a musical and mechanical bent entered business; one graduated from Northwestern Dental College and practiced dentistry until his untimely death at the age of 29; and one was Bernard Dodge.

Bernard Dodge spent the first twenty years of his life working on his father's farm, a period which he describes as interesting and eventful. He recalls that at the age of ten a bumper crop of sorghum required operation of the mill day and night during the rush period of syrup making. At such times his father, his two older brothers and he worked 18 hours at a stretch. His job was to stand on the circling horse-power platform and drive the horses, walking sideways to avoid dizziness. Dodge's stretch began at midnight—you can imagine the reluctance with which a boy of 10 came from his warm bed to drive the horses of the sorghum mill, but a silver 50-cent piece from his father quickly overcame that reluctance. That winter, he had his first regular job—walking over a mile to the schoolhouse each morning with temperatures far below zero at times—to sweep out the schoolhouse and build the fire, at five cents each school day.

Perhaps because his help was needed on the farm, Bernard Dodge did not complete his high school education until he was 20 year of age. He taught school and then entered the University of Wisconsin as a special student in 1896 but before the college year was completed his funds were exhausted, and he found it necessary to return to teaching, first in the district schools and then as high schol principal in Greenwood, Wisconsin. By the time he was 28 he could afford to resume his formal education and spent

a year meeting the requirements for graduation from the Milwaukee Normal School. To recoup his finances he once more returned to teaching, serving as high school principal at Algoma, Wisconsin.

In 1906 he married Jennie S. Perry, and in 1908 at the age of 36 returned to the University of Wisconsin where he completed the requirements for the Ph.B. degree in 1909.

In high school, Dodge had a three month's course in botany in which each student was required to collect and identify 75 plants, using the keys of Gray's School and Field Botany. Dodge far exceeded the required number. As a special student in 1896 at the University of Wisconsin, he became interested in the lower plants, especially the liverworts, largely because of the instruction given by Charles R. Barnes. Then, while principal of the Algoma high school, on the way back from collecting for his class Spirogyra and Hydrodictyon in a local swamp, he met an elderly Bohemian tailor with his dog, his pipe, and a basket, leading his cow in for the evening milking. Dodge learned that the curious objects in the basket were "Pilze" and that they were "Gut für essen." For the first time, he found out what a mushroom looked like. His interest aroused by this chance meeting, he collected fungi in the vicinity of Algoma (a list of these was later published in the Transactions of the Wisconsin Academy of Sciences), sent specimens to the University of Wisconsin for identification, bought Atkinson's book on mushrooms, and Mrs. Dodge presented him for Christmas, MacIlwain's *"One Thousand Edible Mushrooms."* This chance meeting with the old Bohemian tailor was, in Dodge's opinion, the lucky accident which led to his long and happy years investigating this fascinating group of plants.

At the University of Wisconsin, he came under the influence of R. A. Harper, at that time one of the great figures in American botany, who was soon to transfer from the University to Columbia University. At Harper's suggestion, Dodge decided to undertake graduate work and accepted a minor position as Assistant and Research Fellow in Botany at Columbia. He and Mrs. Dodge moved to New York City in the summer of 1909 and three years later Dr. Dodge received the degree, Doctor of Philosophy.

He remained at Columbia as Instructor of Botany until 1920. These eleven years in poorly paid minor positions must have been difficult indeed for a married man approaching 50 before they ended; not to mention his wife whose whole-hearted support and sympathetic interest were major factors in making it possible for Dr. Dodge to pursue his chosen field during these years. In 1920, he accepted an appointment as Plant Pathologist (in fruit diseases) in the Bureau of Plant Industry of the United States Department of Agriculture, and spent eight satisfying years in Washington. Years later I visited with him the house he built there and listened as he extolled the view and detailed the labors which settling this new home and its grounds had required. It was here that Dodge initiated his studies of *Neurospora*. By 1928 the New York Botanical Garden had decided that it required a plant pathologist to maintain the health of its living collections and Dr. Dodge was appointed. He remained in this position until he retired in 1947 to become Plant Pathologist Emeritus and Consultant in Mycology. At his request he was relieved of his duties as consultant in 1957. After retirement he continued to work in his laboratory until a few months before his final illness, making his way several times each week by subway, nearly an hour's journey, from his apartment in the vicinity of Columbia University to The New York Botanical Garden.

Dr. Dodge's concern with fungi as causes of disease extended from plants to animals, including man. From 1928 to 1939 he served as Consultant in Mycology for the Presbyterian Hospital, New York City, and from 1929 to 1950 he was Lecturer in Dermatology for the College of Physicians and Surgeons of New York City.

For about 20 years he was responsible for the practical control of plant diseases and insect pests at The New York Botanical Garden—the rose garden was his special care and delight—and along with this burden pursued research in plant pathology, cytology and genetics, wrote in cooperation with Dr. H. W. Rickett a text on the diseases of ornamental plants, and played a responsible role in local, national and international botanical organizations. But Dr. Dodge, like his father before him, was essentially a teacher and nothing pleased him more than to enthuse some beginner or colleague for the subject in which he took so great an interest, and few could resist him. It is im-

possible to list all those who felt his influence. They include Carl Lindegren, I. H. Hirshkowitz, Myron Backus, S. F. Pady, Jesse Singleton, Esther Zimmer Lederberg, Marjorie Swift, Alice Aronescu, F. Li Tai, Thomas Laskaris, George Bistis and many others. One of his great satisfactions was to receive in 1958 a letter signed by eight members of the Algoma High School Class of 1908 sending him greetings and expressing their gratitude for his patience, guidance and personal interest in them when he was their teacher, and acknowledging the effect on them of his ideas and ideals and of his intense desire to impart his knowledge.

Dr. Dodge, with the loyal cooperation of Mrs. Dodge, held nearly every position which the Torrey Botanical Club afforded. He was secretary-treasurer at a time when the position included a multitude of duties, recording the minutes, collecting money and keeping records of all receipts and expenditures, negotiating contracts with printers, writing letters, and last but not least, delving into the depths of the sub-basement at Columbia University, ferreting out from the dust covered stock and the debris back numbers of the Bulletin and shipping them to all parts of the world. For several years, he was editor of the Bulletin and for many years collaborated with Mrs. Dodge, who served as Bibliographer.

He was elected President in 1940, and volume 47 of the Bulletin was dedicated to him in recognition of his services to the Torrey Botanical Club and his standing as a botanist.

Dr. Dodge was a big man physically as well as mentally. Blond, blue-eyed, fine looking, he was over six feet in height and weighed 190 pounds in his prime. He was proud of his strength and recalled that in his youth he carried 120 lbs. of wheat on his shoulder at threshing time. He was modest to an extreme, a bit shy, not aggressive, friendly, cheerful, good natured, never bitter—though some of his experiences might so have inclined a lesser man. I never heard him make a mean remark about anyone. He played no instrument, but loved good music. His quick, at times almost jerky, motions made one a little reluctant to be a passenger in his automobile (in 40 years driving he never had an accident) and one was always a bit surprised that he could pick a single spore from an ascus with no more equipment than a sharpened sewing needle fixed in a simple wooden handle.

His mental processes were quick also—often to the confusion of others whose habit of thought was more pedestrian. At one time he enjoyed a good cigar and smoked a pipe but gave up smoking completely in the early 30's, as one individual's protest against what he considered to be an unjustified increase in the price of tobacco. He was inclined to be a conservative in politics. Formal religion does not appear to have been important in the lives of his parents—none of their seven children was baptized; he himself was affiliated with the Episcopal church.

Dr. Dodge's contributions to science were widely recognized in this country and abroad. He was a member of Sigma Xi, a member of the National Academy of Sciences, Fellow of the American Academy of Arts and Sciences, Fellow of the American Association for the Advancement of Science, Foreign Member of the Linnean Society of London and Honorary member of the British Mycological Society. He was honored by being chosen a Vice-president of the 7th International Botanical Congress at Stockholm, President of the Mycological Society, and of the Torrey Botanical Club. When he received the Golden Jubilee Award of Merit of The Botanical Society of America, the citation read,

> "Bernard Ogilvie Dodge, whose perceptive researches into the taxonomy, evolution and pathological relations of the fungi have not been surpassed, but only overshadowed, by his discovery and exploitation of *Neurospora* as a principle of genetical truth."

Contributions of Bernard O. Dodge to Biochemical Genetics

E. L. Tatum

In paying tribute to Dr. Bernard O. Dodge at this Memorial Meeting of the Torrey Botanical Club, I want to emphasize first and foremost that Dodge's long career in mycology was characterized throughout by a true love and enthusiasm for his molds. The contributions to which his love and enthusiasm for the fungi led have played a major

role in the development of biochemical genetics, although his own researches were not actually in this field. Both as an investigator and as a teacher, his career inspired and will continue to inspire mycologists, microbiologists, and geneticists.

It is worthy of note that in his 45 years of active research, from 1912 to 1957, Dodge published a total of 162 papers, 42 on *Neurospora*. The first of these, the classic paper of Shear and Dodge, was published in 1927, and the last six of his published papers also dealt with this organism.

In order to trace Dodge's contributions to biochemical genetics through Neurospora, I want to refer briefly to the history of this organism. Under the name Monilia, F.A.F.C. Went, the Dutch botanist and plant physiologist, first became interested in this pink mold during his stay in the Dutch East Indies. He was forced to postpone his investigations on sugar utilization by Monilia until his return to Holland, since the humid climate of the Indies was not suitable for pure culture work. After Went's physiological investigations, Monilia was essentially forgotten until the early 20's when Dr. Dodge became interested in it and started his intensive investigations which led to the renaming of the organism as *Neurospora*.

In 1927, Dodge published the first results of his investigations on the biology and genetics of *Neurospora*. In this work he defined the life cycle of the organism, distinguished three genera, and named them *crassa*, *sitophila*, and *tetrasperma* (Shear and Dodge, 1927). In later work, he clarified the mechanism of mating type inheritance and showed that this was determined in Neurospora by a single pair of alleles (Dodge, 1929). He studied a number of morphologically different mutations of spontaneous origin and established that the phenomenon of sex linkage occurs in this fungus. The character which he studied in this respect he termed "albinism," which we would now class as "aconidial" (Dodge, 1930). He defined two types of asexual spores, the uninucleate microconidia (spermatia) and the multinucleate, orange colored macroconidia, and studied the mechanism of their production from Neurospora hyphae and their functions in fertilization (Dodge, 1932). He showed also that Neurospora has genetic characteristics similar to other organisms, such as Drosophila, in that the occurrence of lethal mutations could be demonstrated. The particular trait which he recognized and studied intensively was a character dealing with ascospore development which he called by the descriptive name, *ascospore lethal* (Dodge, 1934). Dodge discovered that this ascospore lethal character in Neurospora could be determined either by a dominant or by a recessive gene (Dodge, 1935, Dodge, 1939a). In connection with this developmental abnormality, he also studied phenotypic mimicking of the gene-determined character (Dodge, 1955).

It is clear from this brief summary of some of the high points of Dodge's work with Neurospora that he was convinced of its versatility and usefulness as a genetic tool, and that he realized fully the basic potentialities of this organism. However, he was well in advance of his time and was almost a lone voice crying in the wilderness for a number of years. Nevertheless, his interest in and enthusiasm for Neurospora led directly to its later use in biochemical genetic studies. Interestingly, Beadle, as a graduate student at Cornell University, heard Dodge lecture on his pet molds. Thomas Hunt Morgan, then at Columbia University, had close contacts with Dodge. He must have been well enough impressed with Dodge's picture of its potentialities to carry a culture of Neurospora with him when he moved to the California Insititute of Technology in 1928. It was there that Lindegren, on Morgan's advice, undertook his dissertation work on Neurospora and studied problems on genetic mechanisms, crossing-over, and related phenomena (Lindegren, 1932). As a consequence of the extensive biological and genetic background provided by Dodge and by Lindegren, Neurospora was the natural choice for an organism in which to attempt the production of mutations relating to biochemical processes.

Well before 1941, when Beadle and I undertook our biochemical genetic studies (Beadle and Tatum, 1941), Dodge had the basic concepts and potentialities of Neurospora in mind and in many respects his vision permitted him to anticipate later developments. This is shown by the beautifully clear statements presented in a paper entitled "Some Problems in the Genetics of Fungi" which was delivered at the 3rd International Congress of Microbiology in New York in 1939 and subsequently published in Science (Dodge, 1939b). In this he said:

> "The fungi in their reproduction and inheritance follow exactly the same laws that govern these activities in higher plants and animals."

He also forecast in this address the advantages of Neurospora for biochemical genetics along a number of different lines which I want to mention briefly.

In relation to gene action, he clearly differentiated between haploid and diploid organisms and pointed out the advantages of a haploid organism, such as Neurospora, for biochemical genetic studies:

> "In genetic studies of higher plants and animals, the effects of factors of inheritance are usually manifest in connection with diploid structures, where each nucleus carries 2 sets of genes, one set contributed by each parent. The haploid mycelium of a fungus shows many variations as to color, types of growth and in the production of propagating bodies of all sorts. The foundation structures of the fruit bodies themselves are haploid. One is, therefore, enabled to observe in the fungi the effects of a single set of genes without the complications which are bound to arise when 2 different sets are present, as in diploids."

He pointed out very clearly the analogy of ascospores to germ cells and their consequent advantages for genetic analysis:

> "Since in Neurospora, gametes of both kinds are derived from a single mother cell, the exact relationship of all 8 is known. The closest possible inbreeding can be done without loss of 3 out of 4 gametes as is the case in animals and seed plants."

Not only did he provide through his work the conceptual theoretical background which made possible the later extensive use of Neurospora, but he contributed information at the technical and practical level which greatly facilitated subsequent investigations. Firstly, he developed techniques of crossing this organism, isolating the products of meiosis, the ascospores, and establishing them in culture. Secondly, his long experience with the fungi permitted him to develop a method of germination of ascospores which was of considerable experimental importance for later studies. In 1912, while studying the germination of ascospores of another fungus, *Ascobolus*, as the story goes, some isolated ascospores were accidentally placed in an oven instead of an incubator. To his surprise and joy, this heat treatment led to a greatly increased frequency of germination (Dodge, 1912). Later when he was studying the segregation of characters in Neurospora by means of ascospore isolation, he applied successfully this same technique of heat activation of ascospores. Thirdly, with Butler and Robbins, he discovered that biotin was the sole complex nutrient needed for the growth of Neurospora (Butler, Robbins, and Dodge, 1941). This information was, of course, vital for the successful use of Neurospora in biochemical studies. Fourthly, in his recognition of the uninucleate nature of microconidia, he anticipated the later use of these spores for studies of mutation, both spontaneous and induced.

It is of considerable interest and significance, I believe, that Dodge's discoveries and views essentially forecast much later developments in the use of Nerospora in biochemical genetics. I have already mentioned his pointing out the advantages of this haploid organism and of its advantages for genetic studies arising from the fact that all four products of meiosis are recovered in the ascospores from a single ascus. To show how nearly he came to anticipating the study of gene-controlled nutritional deficiencies in this organism, I wish to quote again from his 1939 address:

> "I have faith . . . that growth substances (and hormones) will prove very useful in inducing a fungus race to develop to the full extent of its potentialities as represented by its factors of inheritance."

Although this quotation is admittedly a little out of context, since it was primarily related to problems of sexuality, it seems to me that Dodge was very close to biochemical genetics.

In connection with his studies, Dodge showed that true dominance in the genetic sense was true in Neurospora only in regard to ascus formation in which he had demonstrated both recessive and dominant lethal genes for ascospore development. He con-

trasted this (Dodge, 1939b) with the so-called dicaryophytes in a heterocaryon:

> "Dicaryophytes . . . are among the most interesting and important phenomena in the whole biology of the fungi . . . They are more interesting for what they are than for what they *are not*. . . . We have not yet opened our eyes to the beauty and significance of these dicaryophytic haploid partnerships."

One may say that his interests in heterocaryons and dicaryophytes led to the later use of this phenomenon in the studies of Beadle and Coonradt (1944) on heterocaryosis, in which it was assumed that only non-allelic genes would supplement each other in this condition. The later discovery (Giles, *et al*, 1957) that certain allelic genes also were capable of complementation in a heterocaryon has opened up an entirely new approach to gene function. This also was to a certain extent anticipated by and made possible by Dodge's basic work on heterocaryons.

So, in summary, it is not too much to conclude that without Dodge and his vision, insight, and imagination, biochemical genetics via later work with Neurospora would not have begun when it did.

Biology therefore owes him a great deal, and on behalf of Beadle and myself and all biochemical geneticists, it is a great privilege to acknowledge our debt by paying this tribute to Bernard Ogilvie Dodge.

Many of us in science can be amateurish professionals, but in the real sense of the words, Dodge, in his work with his fungi, was a true professional amateur.

THE ROCKEFELLER INSTITUTE.

Literature Cited

Beadle, G. W., & Coonradt, V. L. 1944. Heterocaryosis in *Neurospora crassa*. Genetics **29**: 291.

Beadle, G. W., & Tatum, E. L. 1941. Genetic control of biochemical reactions in Neurospora. Proc. Nat. Acad. Sci. **27**: 499.

Butler, E. T., Robbins, W. J. & Dodge, B. O. 1941. Biotin and growth of *Neurospora*. Science **94**: 262–263.

Dodge, B. O. 1912. Methods of culture and the morphology of the archicarp in certain species of the Ascobolaceae. Bull. Torrey Bot. Club **39**: 139–197.

————. 1929. The nature of giant spores and segregation of sex factors in *Neurospora*. Mycologia **21**: 222–231.

————. 1930. Breeding albinistic strains of the *Monilia* bread mold. Mycologia **22**: 9–38.

————. 1932. The non-sexual and the sexual functions of microconidia of *Neurospora*. Bull. Torrey Bot. Club **59**: 347–360.

————. 1934. A lethal for ascus abortion in *Neurospora*. Mycologia **26**: 360–376.

————. 1935. A recessive factor lethal for ascospore formation in *Neurospora*. Bull. Torrey Bot. Club **62**: 117–128.

————. 1939a. A new dominant lethal in *Neurospora*. J. Heredity **30**: 467–474.

————. 1939b. Some problems in the genetics of the fungi. Science **90**: 379–385.

————. 1955. Phenocopies in *Neurospora*. J. Heredity **46**: 1–8.

Lindegren, C. C. 1932. The genetics of *Neurospora*. I. The inheritance of response to heat treatment. Bull. Torrey Bot. Club **59**: 85.

Shear, C. L. & Dodge, B. O. 1927. Life histories and heterothallism of the red bread mold fungi of the *Monilia sitophila* group. J. Agr. Res. **34**: 1019–1042.

The Importance of B. O. Dodge's Work for the Genetics of Fungi

FRANCIS J. RYAN AND LINDSAY S. OLIVE

"What a remarkable man!" This was the statement so often heard from a new student who had met Dr. B. O. Dodge for the first time. As he walked through our Columbia laboratories and saw either of his old favorites, *Ascobolus magnificus* or a new isolate of *Neurospora*, he would shout with pleasure, and everyone on the floor would know he was there. Or, upon seeing an old student or associate strolling through the grounds of the Botanical Garden, he might toss his hat into the air in enthusiastic greeting. Trans-

fixed by a picture of *Pilobolus* in his old stereoptican viewer, he would exclaim to students little more than: "Oh, boy! Oh, boy!"

We will remain transfixed by Dodge's image. He was a kaleidoscope on the scientific scene, a sound and important scientist, motivated by unfailing curiosity, good will, and perennial optimism, a man who has helped bring Science in America to a position that does not embarrass us before our colleagues in other parts of the world. Dodge and his favorite organism, *Neurospora*, have had a specific and lasting influence on the course of biological research.

He had passed the age of 40 when his first paper in mycology was published, his last appeared when he was 85. He was 55 when his major work—the genetics of *Neurospora*—began. What a supreme example for those of us whose faith falters! In 1920, Dodge discovered heterothallism in the ascomycetes, using *Ascobolus magnificus*, a new species described by him. In 1927 he started his genetic studies of *Neurospora*, and it was several years before even he fully appreciated the significance of his findings. The new field of study which he opened up had been anticipated in the work of Blakeslee, Burgeff, Kniep, and Brunswick, but probably no other investigator in this field carried through with his energy and drive, or can trace in a direct line so much influence on the work of others.

Dodge once wrote: "Mycologists who undertake the study of ascomycetes or other fungi will always be handicapped by their lack of that training which is necessary for adequate analysis of any extensive breeding work. . . . On the other hand, geneticists without mycological training undertaking to study the ascomycetes should realize that the ways of these fungi are devious and beset with pitfalls." After his first papers had demonstrated the excellent potentialities of *Neurospora* for genetic investigation, he took his own counsel and with the aid of the geneticist, Carl Lindegren, showed that *Neurospora* obeyed the basic laws of genetics. Dodge's studies on the heredity of fungi were always adventurous, imaginative, and progressive. Indeed, they were largely responsible for the accelerated adoption of microörganisms as research tools which, with the refined techniques devised by Beadle, Tatum, and others, has led to the present day explosive progress in genetic fact and concept.

Dodge, with assistance from his associates Wilcox and Lindegren, gave an adequate cytogenetic account of the inheritance of mating type which stands today. Soon the segregation of other factors fell into place, as well as the significance of second division segregation, which is the basis of tetrad analysis. All this seems commonplace now, but then there were traditional attitudes to be broken. Dodge needed and asked for help from his friends, the trained geneticists. He was not proud, but insatiably inquisitive.

He was especially fond of problems in hybridization of fungi, and particularly liked to use *Neurospora tetrasperma* in his studies. He used it to define the phenomenon of "heterokaryotic vigor" in fungi and felt that the organism could be made to perform many more tricks for his illumination—which, indeed, it did. He had much to do with the adoption of *Neurospora* by the biochemical geneticists through his discovery, with Butler and Robbins, that biotin was a growth factor requirement. This allowed the use of a chemically defined medium and the advances in understanding in this field.

Although Dodge considered himself primarily a mycologist, he was able to move from one field to another and retain his capacity for suspended judgment along with an impulse for progress. Designs in nature—the physics of living things—fascinated him. He would bring in pine cones, snail shells and plant stems and pore over them for months during his spare time, marvelling at the spiral designs in all of them and making sketch after sketch.

Dodge did not hesitate to answer the criticism of any opponent, but he never held a grudge against anyone who disagreed with him. He simply could not harbor ill will. His mind was always open to ideas that did not agree with his own. He would often say: "If anybody can show I'm wrong, I'm all for him! In fact, I'll give him the cultures of any of my fungi to disprove me with!" If he were wrong, his curiosity and integrity would demand the facts. Yet his basic confidence in his findings was strong. He often said that he wished his epitaph to read, "A dikaryon is not a diploid!" So it shall be recorded.

During each of his later years, Dodge would bring into our laboratories a set of

cultures of *Neurospora tetrasperma*, forgetting that he had done so the year before. He would fondly go over each, giving its origin and characteristics, and then would leave them with us, hoping that someone would be interested in taking up where he left off. Someone will, of course. We are holding them for the use of future students who will be stimulated by his work and the legacy of ideas that he left behind.

B. O. Dodge's Contribution to Plant Pathology

P. P. PIRONE

As Dr. Dodge's successor as plant pathologist at the New York Botanical Garden, I have been asked to discuss his contribution to plant pathology. Before doing so, however, I would like to interject a few personal observations on the man we memorialize this evening.

In the last thirteen years of his life, I had, because of almost daily contact, a splendid opportunity to get to know him. Always cheerful, he was also ever ready to offer advice and help when I sought it. His pleasant, subdued whistling as he approached his office in the Museum Building was a familiar sign that a fine old gentleman was arriving for another of his post-retirement day's work. Always a handsome gentleman, he had an air of dignity few men possess. I, for one, will miss him very much.

Although Dr. Dodge published his first paper in 1912 in the Bulletin of the Torrey Botanical Club, it was not until 1916 that one of his papers dealt with a plant pathological subject. The publication "Fungi Producing Heart-Rot of Apple Trees" described several fungi, particularly *Polyporus admirabilis*, affecting apple trees in the Connecticut-Southeastern New York area. The paper was published while he was an instructor in botany at Columbia University.

In 1920 Dr. Dodge went to the U. S. Department of Agriculture as a plant pathologist investigating fruit diseases. During the nine years with this organization he was author and co-author of a number of publications. These included diseases of raspberries, blackberries, and dewberries. Associated with him in some of the publications were such famous names in plant pathology and mycology as C. L. Shear, N. E. Stevens, Frederick A. Wolf and R. B. Wilcox.

In my opinion his best plant pathology publications during this period, were those dealing with systemic infections of the genus *Rubus* with the orange rusts, published in the Journal of Agricultural Research. Even today these are models of outstanding research and lucid writing. I have it on good authority that Dr. Dodge always felt that his studies on systemic rusts were among his best works. That authority, by the way, is none other than Mrs. B. O. Dodge. Another excellent contribution, was the publication in 1926 with R. B. Wilcox, of U.S.D.A. Farmer's Bulletin 1488 entitled "Diseases of Raspberries and Blackberries." This was revised in 1941. It was during this most productive period, too, that he worked with Neurospora.

Upon his appointment as Plant Pathologist at the New York Botanical Garden in 1928, his interests, quite naturally, changed from diseases of fruits to those which afflict ornamental plants.

Most of the work on ornamental plant diseases during Dr. Dodges' nearly twenty years' tenure as plant pathologist were published in the Journal of the New York Botanical Garden, now known as the Garden Journal of the New York Botanical Garden. These included his researches and observations on diseases of iris, Japanese cherries, roses, geraniums, cedars, marigolds, opuntias and many other ornamental plants.

Under his direction and with a grant from the American Delphinium Society, one of his assistants, Thomas Laskaris, made a comprehensive study of the diseases of delphinium.

Although his later years were devoted primarily to genetics of fungi, he published in the Bulletin of the Torrey Botanical Club in May 1951, in his 79th year, an article entitled "A fungus capable of parasitizing wharf-piling borers."

I believe that one of Dr. Dodge's greatest and most lasting contributions to plant

pathology was the publication, in his 71st year, with Dr. H. W. Rickett of a 638 page book "Diseases and Pests of Ornamental Plants," the first book in its field published in America. It was preceded by a book in German on the same subject, by Heinrich Pape a few years before.

Perhaps it would be well to describe the format of the book for those in this audience who are unacquainted with it. The early part is devoted to a general discussion of plant disease symptoms; and to bacteria and fungi. Because of his excellent training in mycology, the discussion of the fungi is one of the best to be found anywhere. Insects and other animal pests and control measures for insects and fungi complete the early chapters. The major part of the book treats with the diseases and insect pests that affect nearly 500 genera of plants, (from *Abelia to Zinnia*) grown out-doors, under glass, or in the home.

This book was well received by scientific workers and professional and amateur gardeners throughout the English-speaking world. It also was the standard text on ornamental disease and insect problems in universities offering courses in plant pathology.

I helped in a slight revision of the book in 1948 and at Dr. W. J. Robbins suggestion, made an extensive revision, with Dr. Rickett's help, in 1959. It is my fond hope that over the years this book will serve as a constant memorial to an outstanding scientist and a fine gentleman—Bernard Ogilvie Dodge.

THE NEW YORK BOTANICAL GARDEN

FIELD TRIP REPORTS

June 12, Canarsie, Brooklyn, New York. In spite of the threat of rain (which turned out to be more than a threat as the afternoon progressed), twelve people turned out for the Canarsie field trip. In all, some 72 species of plants were observed, 13 of which seem not to have previouscly been reported from the county. In order to conserve space and to avoid needless repetition, species reported on the August 30, 1959, field trip to Marine Park have been eliminated from the list of plants observed. Plant names preceded by one asterisk (*) have not hitherto been recorded from Kings County; at least they do not appear on the New York State Museum check list for Kings County; plant names preceded by two asterisks (**) were seen by the leader for the first time on this trip; those not otherwise identified were on the state check list.

Populus balsamifera
**Betula populifolia
*Broussonetia papyrifera
Morus alba alba
*Polygonum cuspidatum
*Rumex acetosella
*Lychnis alba
*Saponaria officinalis
*Silene cucubalus
*Sassafras albidum
*Capsella bursa-pastoris
*Potentilla recta
*P. Simplex
*Prunus serotina
**Rubus phoenicolasius
*Medicago sativa
*M. officinalis
**Robina pseudo-acacia
*Trifolium pratense
*Ailanthus altissima
*Acer pseudo-platanus
**Parthenocissus quinquefolia
*Hypericum perforatum
*Pastinaca sativa
**Lysimachia quadrifolia
*Convolvulus sepium sepium
**Linaria vulgaris
*Verbaseum blataria
*Plantago rugelii
*Lonicera japonica
**Tragopogon pratensis
*Taraxacum officinale
*Erigeron strigosus
**Typha angustifolia
*Agropyron repens
**Calamagrostis canadensis
Dactylius glomerata
Poa compressa
P. pratensis
**Carex lurida
*Scirpus atrovirens
**Juncus effusus
Allium vineale
Asparagus officinalis
**Smilax glauca
**Tradescantia virginiana

Leader, Karl L. Brooks

June 26, Johnsonburg, Warren County, N. J. The area visited was in the limestone region of Warren County. It consisted of a small pond surrounded by a sedge mat, and this in turn was surrounded by a deciduous swamp. The outer fringe was composed of numerous limestone outcrops. Investigations might profitably be held in the area next year in late May. The cotton sedge, *Eriophorum viridi-carinatum*, was scattered among the tall grasses most of which went unidentified. *Carex flava* was truly abundant as was the bog buckbean, nowhere in New Jersey have I seen as much of the latter. *Epipactis* continues to spread in the areas where lime occurs. (The source of lime may be quite unnatural, for Louis E. Hand located a station for the Hellebore Orchid at Medford Lakes, Burlington County, in which the lime source was a discarded bag of cement!). Seven species of orchids were located without special effort expended. The Carolina wren was the bird which excited the most interest.

Among the plant species observed were: *Cystopteris bulbifera, Camptosaurus rhizophyllus, Asplenium trichomanes, Pellaea atropurpurea, P. glabella, Eriophorum viridi-carinatum, Cladium mariscoides, Carex flava, Chamaelirium luteum, Trillium cernuum, Cypripedium parviflorum, C. reginae, Calopogon pulchellus, Pogonia ophioglossoides, Epipactis helleborine, Corallorhiza maculata, Liparis loeselii, Betula pumila, Sarracenia purpurea, Drosera rotundifolia, Potentilla fruticosa, Rhamnus alnifolia, Asclepias purpurascens, A. exaltata*, and *Menyanthes trifoliata*. Attendance 52. Leader, David Fables.

July 2, Martha-Harrisville, Burlington County, N. J. The most unusual species located was the reversed bladderwort *Utricularia resupinata* no other station for which is currently known in New Jersey. About 75 plants were noted. Several plants of *Rhynchospora oligantha*, the few-flowered beaked-rush, were found. This makes about six stations for the species, which Stone recorded but once, near Speedwell. The remainder of the species were typical of the ara, *Pogonia, Rhexia, Polygala* etc., except the spreading pogonia, *Cleistes divaricata*, which a few of us sought, to see if it was still in good condition—fortunately, it was, and the population totalled 6. Among the plant species recorded were: *Sagittaria graminea, Danthonia epilis, Rhynchospora oligantha, Xyris congdoni, Tofieldia racemosa, Narthecium americanum, Habenaria lacera, Utricularia cornuta, U. juncea, U. resupinata, U. fibrosa*, and *U. subulata*. Attendance 26. Leader, David Fables.

Aug. 28, New Lots, Brooklyn, New York. Twelve people were present for the New Lots field trip, on which 79 species of plants were observed, only 4 of which had not previously been seen by the leader. Again, species previously reported have been eliminated from the list, and the use of asterisks follows that of the Canarsie report.

Myrica pensylvanica
*Polygonum aviculare
**P. orientale
*P. scandens
**Acnida cannabina
*Amaranthus retroflexus
Cycloloma atriplicifolium
Rorippa islandica hispida
Platanus occidentalis
*Medicago lupulina
*Rhus glabra
*Abutilon theophrasti
Hibiscus moscheutos palustris
**Campsis radicans
Sonchus oleraceus
Aster ericoides
*Galinsoga ciliata
*Solidago altissima
*S. Juncea
*Solidago rugosa
**Typha latifolia
Agrostis hyemalis
Aristida dichotoma
Cenchrus tribuloides
Elusine indica
Eragrostis pectinacea
Setaria faberi
*Commelina communis ludens
*Juncus tenuis
Leader, Karl L. Brooks

Oct. 23, Southfields, Orange Co., N. Y. Joint trip with the New School mycological class; attendance over 30. Mr. Nearing said that on a previous exploratory trip to the area he had counted 84 species of lichens. Soil, rock and bark truly seemed to be wholly covered with ornate grey-green incrustations of varied kinds. Several of the most common *Cladonias* were found. *C. verticillata*, branched stalks girdled with circular crenulate

flaring platforms, looking like miniature pagodas; *C. chlorophaea*, Pyxie Cup or Goblet, gracefully stemmed, ornamented with crenulate scales at the base; *C. coniocraea*, Powder-Horn, as so aptly named by Mr. Nearing; *C. squamosa*, frosted with the tiniest crinkled scales; *C. furcata* and Reindeer Moss, intricately ramifying shrublets, similar but differing in shade of grey. *Parmelia physodes* grew on the bark of a tree, grey-green above and brownish beneath, the edges puffed up into bladders. About six genera of liverwort were examined, including *Blasia pusilla* and *Lophozia bicrenata* (fruiting), and several mosses, including the large-leaved *Mnium punctatum* var. *elatum*. The fungi were numerous, although not as abundant as usual, e.g.: *Merulius tremellosus*, resupinate, hymenium of translucent salmon-colored intricately anastomosing wrinkles; *Hypoxlon*, black like a knob of coke or pitch; *Pleurotus serotinus*, cap colored burnt-brown faintly olivaceous; *Polyporous brumalis*, a stemmed species, cap almost black, pore surface whitish; *Helotium* (*Calycella*) *citrinum*, crowded discs like minute lemon-colored peziza, but inopereulate. One yellowish lignicolous fungus with almost central stem, not recognized in the field as to genus, was subsequently identified as *Pleurotus sulfuroides* by Eleanor Yarrow (who also named the *Merulius* and *Helotium*), and the determination was checked by Dr. Clark T. Rogerson. Guest-leader, Guy Nearing. Reported by Joseph Monachino.

Oct. 29, Rutgers Display Gardens, New Brunswick, New Jersey. Weather overcast with showers. Eighteen members gathered at 10:30 A.M. for a tour of the holly and other berried plantings and an opportunity to watch the birds. *Ilex verticillata*, and *Ilex laevigata* and *Ilex glabra* were showing bright color. The growing season has been excellent, but the autumn has been mild with ample moisture. Several cultivated plants were observed in flower: *Ilex aquifolium, Rhododendron arbutifolium, R. mucronatum, Osmanthus ilicifolius, Elaeagnus pungens reflexa* and of course *Hamamelis virginiana*. Leader, Robert B. Clark.

Local Flora Notes

On October 28, 1960 the New York State Museum conducted a symposium on botanical exploration in New York State. It marked the official opening of the new State Botanist's office and its research facilities. The discussions on fungi, algae, and mosses were conducted by Drs. Clark T. Rogerson, George J. Schumacher, and Edwin H. Ketchledge respectively. After tea in the herbarium, the late afternoon was devoted to the vascular plants with Dr. Robert T. Clausen, Chairman of this section. At a banquet in the evening, Dr. William C. Steere, Director of the New York Botanical Garden was the guest speaker. There were about seventy persons present at the meeting. In addition to Drs. Steere and Rogerson, the Torrey Club was represented by Dr. Jack McCormick and the writer of these notes. The enthusiastic turnout was encouraging, denoting as it did a continuing interest in the flora of New York State, particularly from the viewpoint of activity in the field.

* * * *

On October 7, 1960 the author received the following communication from Mr. Joseph Monachino.

"Note on Phellodendron.

Phellodendron on Long Island. The genus was excluded from our spontaneous flora by Gleason in his New Britton & Brown. The plant that had spread in the woodlands of his own home-grounds, the New York Botanical Garden, Dr. Gleason regarded as a mere fortuitous escape. Yet I had seen it wild also in Staten Island and years ago in Forest Park. On October 1, 1960, I revisited Forest Park, Queens, New York City, and proceeded to count the individual plants of *Phellodendron* I encountered, but quit after numbering over 500. The cork-tree is widespread in Forest Park, sometimes being the dominant element of its height-class. If you should ask what is the common tree in Forest Park with opposite, pinnately compound leaves, the answer must be, not ash, but *Phellodendron!* (The ash is lacking or very rare there.) The plant shows somewhat of a suckering habit, forming clumps 5–10 feet high, or grows into a tree exceeding 30 feet. The few fruiting specimens seen in Forest Park were surrounded at their base by a vast number of trifiliolate young seedlings. I did not determine the species (the leaves were more or less pubescent beneath, particularly on the veins). Most of the area is a

moderately shaded mesophytic oak-woodland, with a benzoin-arrow-wood association in the shrub level. It is the best place in the city for *Cornus alternifolia*. The ground herbs are species associated with woodland aster. *Collinsonia canadensis* cited as rare on Long Island, is not rare here. The park stands on the terminal moraine, with its stony soil and rolling topography of hollows and hillocks."

* * * *

In another communication, this one from Mr. Robert Meyers to the writer, Mr. Meyers makes some further observations on *Aegilops cylindrica* which he first found on Staten Island in 1949. He says "It was still growing at the same station where it was first found, although there are only a few plants this summer (1960). Yet it has persisted, in spite of competition from *Agropyron repens* growing in the same area."

Concerning *Aegilops cylindrica* Mr. Joseph Monachino says "The species illustrated as *Aegilops cylindrica* in Gleason's New Ill. Fl. 1: 142 is a form of *A. triuncialis* L. The specimen used for the drawing was collected by Bicknell at the Yonkers Wool Mill on June 26, 1898. Our determination has been checked by Jason R. Swallen.

* * * *

In a continuing investigation of floras of the local range which have been written since the publication of Taylor's "Flora of the Vicinity of New York" in 1915 and which were not noted in "Torreya" the writer adds the following:

Egler, Frank E. (Aton Forest, Conn.). A Cartographic Guide to Selected Regional Vegetation Literature.—Where Plant Communities Have Been Described. Part 1. Northeastern United States. Sarracenia 1: 1–50, Aug., 1959. Institut Botanique, De L'Universite de Montreal, Montreal, Canada. Although this is an ecological bibliography its references in many instances concern the flora of the local range. The "Wildlife Review" of the U. S. Dept. of Interior, Fish and Wildlife Service says "This bibliography covers the literature on 'vegetation' as distinct from that on 'flora.' The annotations in every case have been phrased for those interested in vegetation science, even though the paper by major content and intent deals with a related field." It "is organized . . . by geographical localities arranged alphabetically and . . . by chronology to reveal the historical developement of our knowledge of the area. The bibliography is limited to terrestrial vegetation . . . state and local floras are not included, since they are adequately covered in other bibliographies. The literature is included through that of 1958." —J. Harry Lehr.

* * * *

The Johnson Reprint Corporation, 111 Fifth Avenue, New York 3, N.Y., has reprinted volumes 1 through 7 of American Journal of Botany. These volumes have been out of print and generally unavailable for years. They cover the years 1914–1920. The price is $22.00 per volume or $150.00 the set.—J.A.S.

* * * *

The Museum Building of the New York Botanical Garden, originally opened in 1900, has been closed for some months to undergo major renovation. This has meant major inconvenience to the staff, quartered temporarily in the Laboratory Building and the Snuff Mill, as well as to all others desiring to use the library, herbaria, and other collections. Reopening of the Museum Building is expected sometime during the spring months.

The history of the New York Botanical Garden is so inextricably associated with that of the Torrey Botanical Club that some special recognition of this modernized facility is a foregone conclusion. Perhaps in early autumn.

Book Reviews

Principles of Plant Breeding. By R. W. Allard. 485 pp. John Wiley & Sons, Inc. 1960. $9.00.

Although the book is intended for undergraduate students it is also a valuable contribution to the literature of plant breeding. The 36 chapters are arranged under nine sections and these are followed by a useful glossary and index.

Some of the recent developments in plant breeding discussed in the book may be of general interest to botanists. One of these developments is the utilization of cytoplasmic and nuclear factors governing male sterility for the production of hybrid seed. The proper use of these factors obviates completely the need for hand emasculation. In some crops hybrid seed production would be entirely prohibitive without the use of such a method.

Another unique development in plant breeding is the transfer of the gene for resistance to leaf rust from the wild grass, *Aegilops umbellulata* (n = 7) to the common wheat, *Triticum aestivum* (n = 21). Dr. E. R. Sears accomplished this transfer by first producing an amphidiploid of *T. diccocoides* (n = 14) × *Ae. umbellulata* (n = 7). The amphidiploid was then used as a bridge for crossing with common wheat. From the backcrosses of the F1 (amphidiploid × *aestivum*) to common wheat he selected a plant which carried the 21 pairs of wheat chromosomes and an extra *Aegilops* chromosome bearing the gene for resistance. Through the use of X-rays, the gene for resistance was transferred from the *Aegilops* chromosome to a *Triticum* chromosome by an intercalary translocation. Plants homozygous for this translocation differ from normal wheat plants primarily in their rust resistance. Does this achievement signal a new epoch of intergeneric transfer of genes?

In this book the discussion of several important subjects, including polyploidy and interspecific hybridization, is lucid, competent, and based on adequate review of the literature. When compared with other similar texts, Professor Allard's book is especially distinguished by the excellent treatment of quantitative variation, selection, heterosis, and by the application of certain concepts of population genetics to plant breeding problems. Moreover, Dr. Allard's restrained evaluation of artificially-induced mutations is welcome. It may be premature to express final judgment on mutation breeding but several published reports concerning the production of useful mutations by radiation and chemical mutagens have not been substantiated.

On the other hand, it seems that the biometric aspects in this book have been expanded somewhat at the expense of other subjects. For example, the discussion of sex expression in Chapter 20 is too general. In the case of male sterility in onions, the diagrams on pages 246–249 are correct but the interpretation in the text is not very clear. There are also a few typographical errors in the genetic formulae on page 248. The discussion of male sterility in corn is too brief, considering the theoretical and practical significance of the published genetic studies. The subject of gene mutation is touched upon only hurriedly in different chapters. One would expect to find a critical discussion of the nature of the gene and gene mutation in relation to chromosome organization in a new text on plant breeding. Furthermore, the book deals primarily with methods of breeding field crops.

What should or should not be included in a textbook is a matter of personal opinion. The several typographical errors could be corrected in a later edition. Professor Allard's book will be useful among other texts on plant breeding for the wealth of information it contains and for the discussion of subjects on which he is a seasoned authority.—Oved Shifriss, Department of Horticulture, Rutgers University, New Brunswick, N. J.

Developing Cell Systems and Their Control. D. Rudnick (Editor). 240 pp. Ronald Press, New York. 1960. $8.00.

This latest volume of papers presented at the annual symposium of the Society for the Study of Development and Growth in 1959 maintains the high standards set in the preceding volumes of the series. The papers are grouped to represent several aspects of the general topic of differentiation and mechanisms which control these phenomena. There are reports by J. T. Bonner, P. E. Tardent, and A. A. Moscona on cellular organization in slime molds, hydroids, and dissociated cell cultures of vertebrate tissues, respectively. The interrelationships of gibberellin action and responding cellular systems in plants is discussed by B. O. Phinney and C. A. West, while C. A. Villee reports on hormonal action in animal systems, and M. Singer's paper concerns chemical control of organ regeneration by the nervous system in amphibians. The last three papers in this volume represent cur-

rent information and interpretations of the biochemistry of cellular response to control. Biochemical sequences in mitosis are reported by H. Stern. A. B. Novikoff discusses the work in his laboratory concerning particulate localizations of enzymes in animal cells, and T. S. Work completes the series with a review of general and some specific aspects of protein biosynthesis in relation to genetic studies.

The remarkable breadth of the biological problems of cellular differentiation is well represented here, although outstanding contributions to these problems such as those of Sonneborn, of Briggs and King, and others, would certainly have added considerably to the scope of the symposium. As it is written in the statements of R. S. Lillie, included in the Foreword to the volume, "One of our most fundamental problems is to determine why the cell builds up proteins of its own specific type . . . the problem of growth in its most general aspects (is) identical with the problem of heredity. . . ." Unfortunately, there is not much emphasis on this identity in the assembled reports. The principal emphasis is on growth, rather than on the interrelationships between growth and heredity.

The considerable advances of the past decade are well represented here, and some of the excitement of these research areas is imparted to the reader. The current volume is a compendium of fascinating problems which have enjoyed diversified experimental approaches to their solution, and which have contributed to the comprehension of basic biological processes active in cellular differentiation.—CHARLOTTE J. AVERS.

INDEX TO AMERICAN BOTANICAL LITERATURE

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WITH THE COLLABORATION OF

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TAXONOMY, PHYLOGENY, AND FLORISTICS

ALGAE

Bennett, Herald D. Algae of West Virginia. I. Mesotaeniaceae and Desmidiaceae. Castanea **25**: 96–101. Sep 1960.

Blum, John L. A new *Vaucheria* [*vipera*] from New England. Trans. Am. Micr. Soc. **79**: 298–301. Jul 1960.

Doty, Maxwell S. & Meñez, Ernani G. *Tiffaniella*, a new genus in the Ceramiales. Trans. Am. Micr. Soc. **79**: 135–144. Apr 1960.

Frenguelli, J. Diatomeas y silicoflagelados recogidas en Tierra Adélia durante las expediciones polares francesas de Paul-Emile Victor (1950–1952). Revue Algol. II. **5**: 3–48. *pl. 1–5*. Mar 1960.

Gerdel, R. W. & Drouet, Francis. The cryoconite of the Thule area, Greenland. Trans. Am. Micr. Soc. **79**: 256–272. Jul 1960.

Hartog, C. den. New sea grasses from Pacific Central America. Pacif. Nat. **1**: 3–8. *fig. 1, 2*. 11 Mar 1960.

Huerta M., Laura. Lista preliminar de las algas marinas del litoral del Estado de Veracruz. Bol. Soc. Bot. Méx. **25**: 39–45. Aug 1960.

Palmer, C. Mervin & Brown, Earle. *Pectodictyon* and other unusual algae from Indiana. Proc. Indiana Acad. **69**: 119–122. 1959 [Sep 1960].

Pujals, Carmen. *Nemalion* (Rhodophycophyta), género nuevo para la flora argentina. Darwiniana **12**: 75–80. Jul 1960.

Sánchez Rodríguez, Elena. Revisión de técnicas histólogicas para el estudio de las algas marinas macroscópicas. Bol. Soc. Bot. Méx. **25**: 23–38. Aug 1960.

Silva, P. C. *Codium* (Chlorophyta) in the tropical western Atlantic. Nova Hedwigia **1**: 497–536. *pl. 107–123*. 1960.

Sovereign, H. E. The diatoms of Crater Lake, Oregon, supplementary note. Trans. Am. Micr. Soc. **79**: 345. Jul 1960.

Thomas, Clarence. Some algae of the St. Meinrad area [Indiana]. Proc. Indiana Acad. **69**: 131–133. 1959 [Sep 1960].

Whitford, L. A. *Heterodictyon planctonicum* L. Whitford and *Chlorosaccus fluidus* Luther; further notes and corrections. Trans. Am. Micr. Soc. **79**: 227–229. Apr 1960.

Wilce, R. T. Studies in the genus *Laminaria*. II. *Laminaria groenlandica* L. K. Rosenv. Bot. Not. **113**: 203–209. 1960.

Wood, R. D. Linnaean types for Characeae. Trans. Am. Micr. Soc. **79**: 219–226. Apr 1960.

BRYOPHYTES

Al-Aish, Matti & Anderson, Lewis E. Chromosome numbers of some Arizona mosses. Bryologist **63**: 17–25. 6 Jun 1960.

Al-Aish, Matti & Anderson, Lewis E. The chromosomes of *Bartramidula carolinae*. Bryologist **63**: 26–29. 6 Jun 1960.

Castle, Hempstead. *Radula pallens* (Swartz) Dumortier, an unrecognized species of the leafy hepatics. Revue Bryol. Lichénol. **29**: 10–25. 1960.

Cridland, Arthur A. Notes on Kansas mosses. Bryologist **63**: 51–53. 6 Jun 1960.

Crum, Howard & Anderson, Lewis E. A bryological contribution from Florida. Bryologist **63**: 32–46. 6 Jun 1960.

Crum, Howard & Williams, Harry. Bryophytes of the Mont Tremblant area [Quebec]. Bryologist **63**: 59–63. 6 Jun 1960.

Grolle, Riclef. Nachtrag zur "Revision der *Clasmatocolea*-Arten." Revue Bryol. Lichénol. **29**: 68–91. 1960.

Ireland, Robert R. Notes on *Pogonatum alpinum* in eastern United States and Canada. Bryologist **63**: 46–50. 6 Jun 1960.

Jovet-Ast, S. Les *Trichocolea* de la Guadeloupe. Revue Bryol. Lichénol. **29**: 47, 48. 1960.

Jovet-Ast, S. Muscinées du Mexique récoltées par Roger Heim en 1956 et 1959. Revue Bryol. Lichénol. **29**: 30–43. 1960.

Kellough, Richard Dean. The bryophyte flora of Clinton County, Ohio. Ohio Jour. Sci. **60**: 278–282. Sep [30 Nov] 1960.

Khanna, K. R. Studies in natural hybridization in the genus *Weisia*. Bryologist **63**: 1–16. 6 Jun 1960.

McGregor, Ronald L. A new species of *Riccia* [*ozarkiana*] from the Ozarks. Bryologist **63**: 30, 31. 6 Jun 1960.

Miller, Harvey A. The bryological foray of the ninth international botanical congress. Bryologist **63**: 53–59. 6 Jun 1960.

Miller, Harvey A. & Scott, E. B. On the identity of *Herberta sakuraii*. Revue Bryol. Lichénol. **29**: 26–29. 1960.

Persson, Herman & Imam, Mustafa. The first find of a *Riella* in Egypt and some words about the distribution of the genus in the world. Revue Bryol. Lichénol. **29**: 1–9. 1960.

Welch, Winona H. Studies in Indiana bryophytes XII. Proc. Indiana Acad. **69**: 123–127. 1959 [Sep 1960].

FUNGI

Batista, A. Chaves, Maia, H. da Silva & Peres, Generosa E. P. Ascomycetes de diversas famílias. Brotéria **29**: 122–149. 1960.

Brewer, D. Studies in *Ascochyta pisi* Lib. Canad. Jour. Bot. **38**: 705–717. Sep 1960.

Butler, Edward E. Pathogenicity and taxonomy of *Geotrichum candidum*. Phytopathology **50**: 665–672. Sep 1960.

Gordon, W. L. Is *Nectria haematococca* Berk. and Br. the perfect stage of *Fusarium oxysporum* Schl. forma *pisi* (Lindf.) S. and H.? Nature **186**: 903. 11 Jun 1960.

Hesler, L. R. A study of *Russula* types. Mem. Torrey Club **21**(2): 1–59. 26 Mai 1960.

Hirschhorn, Elisa. Acción de gases de formaldehido sobre *Ustilago maydis* y algunos caracteres de las mutantes producidas. Revista Invest. Agr. Buenos Aires **14**: 295–306. *pl. 1, 2.* 1960.

Hirschhorn, Elisa. Ustilagineas nuevas o críticas para la flora argentina. Revista Invest. Agr. Buenos Aires **14**: 307–314. *pl. 1–7.* 1960.

Hudson, H. J. & Ingold, C. T. Aquatic hyphomycetes from Jamaica. Brit. Mycol. Soc. Trans. **43**: 469–478. *pl. 11.* Sep 1960.

Ingold, C. T. Aquatic hyphomycetes from Canada. Canad. Jour. Bot. **38**: 803–806. Sep 1960.

Johnson, T. W. & Hughes, Gilbert C. *Robillarda phragmitis* Cunnell in estuarine waters. Brit. Mycol. Soc. Trans. **43**: 523, 524. Sep 1960.

Rick, Johannes. Basidiomycetes Eubasidii in Rio Grande do Sul—Brasilia. 2. Thelephoraceae. Iheringia **4**: 61–124. Mai 1959. 3. Hypochnaceae, Clavariaceae, Craterellaceae, Hydnaceae. Iheringia **5**: 125–192. Aug 1959.

Royes, Joy & Loveless, A. R. *Poria carbonacea* (Berk. & Curt.) Cooke as a cause of timber rot in Jamaica. Brit. Mycol. Soc. Trans. **43**: 571–577. Sep 1960.

Sowter, F. A. The lichens of Cornwallis Island, N.W.T. Revue Bryol. Lichénol. **29**: 120–123. 1960.

Vágás, E. & Maácz, G. J. A quick method for staining the hyphae of *Ustilago maydis*. Stain Tech. **35**: 220–222. Jul 1960.

Viégas, A. P. *Porotenus* n. gen. Uredinearum. Bragantia **19**: xcv–xcix. Jun 1960.

Viégas, A. P. Uma ferrugem [*Phakopsora colubrinae*, sp. nov.] do saguaragi. Bragantia **19**: ci–ciii. Jun 1960.

Weresub, Luella K. & Gibson, Shelagh. *"Stereum pini"* in North America. Canad. Jour. Bot. **38**: 833–867. *pl. 1–4.* Sep 1960.

Ziller, W. G. *Cacoma faulliana*, synonym of the tree rust fungus *Melampsora albertensis*. Canad. Jour. Bot. **38**: 869, 870. *pl. 1.* Sep 1960.

PTERIDOPHYTES

Bookout, Henry. A new station for *Trichomanes petersii* in Georgia. Am. Fern Jour. **50**: 246, 247. Jul–Sep 1960.

Brownlie, G. Studies on Pacific ferns, Part II, *Humata* and *Ctenopteris*. Pacif. Sci. **14**: 400–402. Oct 1960.

Diem, José. Pteridófitas nuevas del Parque Nacional de Nahuel-Huapi (Argentina). Darwiniana **12**: 67–74. Jul 1960.

Hutto, Thomas A. Two new Georgia stations for *Lycopodium complanatum* var. *flabelliforme*. Am. Fern Jour. **50**: 240. Jul–Sep 1960.

Joe, Barbara. Ferns cultivated in California: *Sadleria*. Am. Fern Jour. **50**: 232–235. Jul–Sep 1960.

Joe, Barbara. The species of *Blechnum* in cultivation. Baileya **8**: 102–117, 30 Sep 1960.

Johnson, M. C. A new evergreen grapefern discovered in Johnson County, Kentucky. Castanea **25**: 103–105. Sep 1960.

Joncheere, G. J. de. Ferns in Oubangi, Congo. Am. Fern Jour. **50**: 228–231. Jul–Sep 1960.

Kramer, K. U. Notes on the pteridophytes of the Dutch West Indies. Acta Bot. Neerl. **9**: 297–301. Oct 1960.

Leatherman, Sylvia. Ferns in cultivation, III. Growing fern balls. Am. Fern Jour. **50**: 235, 236. Jul–Sep 1960.

Tindale, Mary D. Vein patterns in *Microsorium scandens* and its allies. Am. Fern Jour. **50**: 241–245. Jul–Sep 1960.

SPERMATOPHYTES

(See also under Ecology: **Lems; Vance & Kucera;** under Genetics: **Prywer L.**)

Alain, *Hermano.* Novedades en la flora cubana. XI [8 sp. nov]. Mem. Soc. Cub. Hist. Nat. **24**: 105–119. *pl. 1.* 10 Sep 1960.

Bacigalupo, Nelida M. Dos géneros de rubiáceas (*Alibertia* y *Schenckia*) unevos para la flora argentina. Darwiniana **12**: 9–16. Jul 1960.

Baranov, A. I. Contributions to the study of *Filipendula palmata* (Pall.) Maxim. and similar Far Eastern species. Bot. Jahrb. **79**: 521–525. 20 Jul 1960.

Barros, Manuel. Notas ciperológicas [*Carex minutisisma* sp. nov.]. Darwiniana **12**: 137–140. Jul 1960.

Braun, E. Lucy. The genus *Tilia* in Ohio. Ohio Jour. Sci. **60**: 257–261. Sep [30 Nov] 1960.

Bravo, H. Reseña de una excursión por los estados del norte de México. Cact. Sucul. Mex. **5**: 51–62. Jul–Sep 1960.

Bray, J. R. A note on hybridization between *Quercus macrocarpa* Michx. and *Quercus bicolor* Willd. in Wisconsin. Canad. Jour. Bot. **38**: 701–704. Sep 1960.

Bergold, G. H. An unusual bigeneric cross [*Catasetum* × *Cycnoches*]. Am. Orchid Soc. Bull. **29**: 585–588. Aug 1960.

Breitung, August J. Cultivated and native agaves in the southwestern United States. 10. Cact. Succ. Jour. **32**: 163–165. Sep–Oct 1960.

Burkart, Arturo. Contribución al estudio del género *Adesmia* (Leguminosae), III. Darwiniana **12**: 81–136, *pl. I, II.* Jul 1960.

Burkart, Arturo. Observaciones sobre dos plantas en vías de naturalización en la Argentina. Darwiniana **12**: 140–143. Jul 1960.

Cannon, Helen L. Botanical prospecting for ore deposits. Science **132**: 591–598. 2 Sep 1960.

Champie, Clark. *Escobaria sneedii* further described. Cact. Succ. Jour. **32**: 138–140. Sep–Oct 1960.

Constable, George E. The Tygart Valley Falls, West Virginia. Castanea **25**: 101–103. Sep 1960.

Davies, P. A. Pollination and seed production in *Shortia galacifolia.* Castanea **25**: 89–96. Sep 1960.

De La Sota, Elías Ramón. *Mamorea singeri,* un nuevo género y especie de Burmanniaceae. Darwiniana **12**: 43–47. Jul 1960.

Dress, William J. Notes on the cultivated Compositae 5. *Hymenoxys.* Baileya **8**: 68–74. 30 Jun 1960.

Fearn, P. The genus *Astrophytum* Lemaire. Natl. Cact. Succ. Jour. **15**: 46. Sep 1960.

Fowlie, Jack A. Observations on a hermaphroditic flower of *Catasetum.* Am. Orchid Soc. Bull. **29**: 589–591. Aug 1960.

Gillett, J. M. & Senn, H. A. Cytotaxonomy and infraspecific variation of *Agropyron smithii* Rydb. Canad. Jour. Bot. **38**: 747–760. Sep 1960.

Graeser, Robert. *Opuntia tuna monstrosa.* Cact. Succ. Jour. **32**: 157, 158. Sep–Oct 1960.

Guzmán H., Gastón & Vela Gálvez, Luciano. Contribución al conocimiento de la vegetación del suroeste del Estado de Zacatecas (República Mexicana). Bol. Soc. Bot. Méx. **25**: 46–61. Aug 1960.

Hall, Marion T. Teratology in *Trillium grandiflorum's* floral organs. Proc. Indiana Acad. **69**: 263–265. 1959 [Sep 1960].

Harris, Stuart K. Three grasses new to Massachusetts. Rhodora **62**: 262, 263. Sep [13 Oct] 1960.

Hodge, W. H. Bermuda's palmetto. Principes **4**: 90–100. Jul 1960.

Horick, Clarence Kl. *Houlletia landsbergi* re-discovered. Am. Orchid Soc. Bull. **29**: 593–596. Aug 1960.

Ingram, John. Notes on the cultivated Polemoniaceae 4. *Gilia.* Baileya **8**: 41–47. 30 Jun 1960.

Ingram, John. Notes on the cultivated Primulaceae 1. *Lysimachia.* Baileya **8**: 85–97. *fig. 28.* 30 Sep 1960.

Jiménez, José de Js. Novelties in the Dominican flora. Rhodora **62**: 235–238. Sep [13 Oct] 1960.

Kleinhampl, Frank J. & Koteff, Carl. Botanical prospecting for uranium in the Circle Cliffs area, Garfield County, Utah. U. S. Geol. Surv. Bull. **1085–C**: 85–104. *pl. 7, 8.* 1960.

Krapovickas, Antonio. Hibridación introgresiva en maníes de la región guaranítica argentina. Revista Invest. Agr. Buenos Aires **14**: 161–175. 1960.

Krapovickas, A. & Gregory, W. C. *Arachis rigonii,* nueva especie silvestre de maní. Revista Invest. Agr. Buenos Aires **14**: 157–160. 1960.

Krapovickas, Antonio & Rigoni, Victor A. La nomenclatura de las subespecies y variedades de *Arachis hypogaea* L. Revista Invest. Agr. Buenos Aires **14**: 197–228. 1960.

Lawrence, G. H. M. *Cissus discolor* and other names in Blume's Catalogus of 1823. Baileya **8**: 52, 53. 30 Jun 1960.

Lindroth, Carl H. Is Davis Strait—between Greenland and Baffin Island—a floristic barrier? Bot. Not. **113**: 129–140. 1960.

Markle, Carrolle A. Contributions to the flora of Wayne County [Indiana], IV. Proc. Indiana Acad. **69**: 266–268. 1959 [Sep 1960].

Martínez Crovetto, Raúl. Revisión crítica del género *Wilbrandia* (Cucurbitaceae). Darwiniana **12**: 17–42. Jul 1960.

Mohlenbrock, Robert H. & Voigt, John W. New plant records from Illinois. Rhodora **62**: 239–241. Sep [13 Oct] 1960.

Moore, Harold E. A new subfamliy of palms—the Caryotoideae. Principes **4**: 102–117. Jul 1960.

Moore, Harold E. *Columnea illepida,* a new species from cultivation—and further notes on *C. Moorei.* Baileya **8**: 54–58. 30 Jun 1960.

Moore, Harold E. *Tradescantia pexata* (Commelinaceae), a new species. Baileya **8**: 98–101. 30 Sep 1960.

Moore, Harold E. *Tripogandra grandiflora* (Commelinaceae). Baileya **8**: 77–83. 30 Sep 1960.

Nicolson, Dan H. A brief review of classifications in the Araceae. Baileya **8**: 62–67. 30 Jun 1960.

Pabst, G. F. J. Notícias orquidológicas—VII. Orquídea Rio de Janeiro **22**: 4–7. Jan–Feb 1960.

Packer, J. G. A note on the nomenclature of the genus *Cleistogenes* Y. Keng (Gramineae). Bot. Not. **113**: 289–294. 1960.

Rambo, Balduino. Apocynaceae riograndenses. Iheringia **3**: 5–23. Mai 1959.

Rambo, Balduino. Asclepiadaceae riograndenses. Iheringia **1**: 3–57. Sep 1958.

Raymond, Marcel. A new *Hypocyrta* [*teuscheri*] from Ecuador. Bot. Not. **113**: 257–264. 30 Sep 1960.

Read, Robert W. *Lisianthus nigrescens.* Baileya **8**: 48–51. 30 Jun 1960.

Reed, Clyde F. Color variations of the seashore mallow, *Kosteletzkya virginica.* Castanea **25**: 106. Sep 1960.

Reeder, John R. The systematic position of the grass genus *Anthephora.* Trans. Am. Micr. Soc. **79**: 211–218. Apr 1960.

Ritchie, J. C. The vegetation of northern Manitoba VI. The lower Hayes River region. Canad. Jour. Bot. **38**: 769–788. *fig. 2, pl. I–IV.* Sep 1960.

Rollins, Reed C. *Arabis perstellata* in Tennessee. Rhodora **62**: 242–244. Sep [13 Oct] 1960.

St. John, Harold. The name of the Indo-Pacific strand *Scaevola.* Taxon **9**: 200–208. Sep 1960.

Schooler, A. B. Wild barley hybrids. I. *Hordeum compressum* × *Hordeum pusillum.* Jour. Hered. **51**: 179–181. *fig. 6.* Jul–Aug 1960.

Shaffer, Keith. *Phalaenopsis lueddemanniana* and its hybrids. Am. Orchid Soc. Bull. **29**: 493, 494. *pl. 1.* Jul 1960.

Simonse, J. P. A possibly new species of *Phalaenopsis.* Am. Orchid Soc. Bull. **29**: 531, 532. Jul 1960.

Soukup, J. Los géneros de las monocotiledóneas peruanas. Biota **3**: 14–17. Mar [Jul]. 45–65. Jun [Aug] 96–122. Oct [Dec] 1960.

Teuscher, H. Three species of *Ornithocephalus.* Am. Orchid Soc. Bull. **29**: 525–527. Jul 1960.

Teuscher, H. Two little-known Ecuadorean epidendrums. Am. Orchid Soc. Bull. **29**: 657–659. Sep 1960.

Troncoso, Nelida S. *Xeroaloysia,* un nuevo género argentino de verbenáceas. Darwiniana **12**: 48–57. Jul 1960.

Vajrabhaya, Thavorn & Randolph, L. F. Chromosome studies in *Dendrobium.* Am. Orchid Soc. Bull. **29**: 507–517. Jul 1960.

Yeo, P. F. The identity of *Aesculus neglecta* Lindley and *A. neglecta* 'Erythroblastos.' Baileya **8**: 59–61. 30 Jun 1960.

ECOLOGY AND PLANT GEOGRAPHY

Ahlgren, Clifford E. Some effects of fire on reproduction and growth of vegetation in northeastern Minnesota. Ecology **41**: 431–445. Jul 1960.

Aller, Alvin R. The composition of the Lake McDonald forest, Glacier National Park. Ecology **41**: 29–33. Jan 1960.

Bliss, L. C. Transpiration rates of arctic and alpine shrubs. Ecology **41**: 386–389. Apr 1960.

Brock, Elbert M. Mutualism between the midge *Cricotopus* and the alga *Nostoc.* Ecology **41**: 474–483. Jul 1960.

Brown, James H. The role of fire in altering the species composition of forests in Rhode Island. Ecology **41**: 310–316. Apr 1960.

Dansereau, Pierre & Arros, Jeno. Essais d'application de la dimension structurale en phytosociologie. I. Quelques exemples européens. Vegetatio **9**: 48–99. 1959.

Davis, Margaret Bryan & Goodlett, John C. Comparison of the present vegetation with pollen-spectra in surface samples from Brownington Pond, Vermont. Ecology **41**: 346–357. Apr 1960.

Dix, Ralph L. The effects of burning on the mulch structure and species composition of grasslands in western North Dakota. Ecology **41**: 49–56. Jan 1960.

Dix, Ralph L. & Butler, John E. A phytosociological study of a small prairie in Wisconsin. Ecology **41**: 316–327. Apr 1960.

Edwards, R. Y., Soos, J. & Ritcey, R. W. Quantitative observations on epidendric lichens used as food by caribou. Ecology **41**: 425–431. Jul 1960.

Evans, Raymond A. Differential responses of three species of the annual grassland type to plant competition and mineral nutrition. Ecology **41**: 305–310. Apr 1960.

Fowlie, J. A. Ecology notes: *Laelia monophylla*. Am. Orchid Soc. Bull. **29**: 501–504. Aug 1960.

Getz, Lowell L. Standing crop of herbaceous vegetation in southern Michigan. Ecology **41**: 393–395. Apr 1960.

Gilmartin, Malvern. The ecological distribution of the deep water algae on Eniwetok Atoll. Ecology **41**: 210–221. Jan 1960.

Godman, Richard M. & Krefting, Laurits W. Factors important to yellow birch establishment in Upper Michigan. Ecology **41**: 18–28. Jan 1960.

Goldstein, Solomon. Degradation of pollen by Phycomycetes. Ecology **41**: 543–545. Jul 1960.

Golueke, Clarence G. The ecology of a biotic community consisting of algae and bacteria. Ecology **41**: 65–73. Jan 1960.

Hagar, Donald C. The interrelationships of logging, birds, and timber regeneration in the Douglas-fir region of northwestern California. Ecology **41**: 116–125. Jan 1960.

Hartman, Richard T. & Graffius, J. Herbert. Quantitative seasonal changes in the phytoplankton communities of Pymatuning reservoir. Ecology **41**: 333–340. Apr 1960.

Jones, Milton B. & Evans, Raymond A. Botanical composition changes in annual grassland as affected by fertilization and grazing. Agron. Jour. **52**: 459–461. Aug 1960.

Ketellapper, H. J. Growth and development in *Phalaris*. I. Vernalization response in geographic strains of *P. tuberosa* L. Ecology **41**: 298–305. Apr 1960.

Lems, Kornelius. Botanical notes on the Canary Islands II. The evolution of plant forms in the Islands: *Aeonium*. Ecology **41**: 1–17. Jan 1960.

Li, Hui Lin. Adaptive radiation in the flowering plants. Jour. Wash. Acad. **50**(2): 1–7. Feb 1960.

Looman, J. & Campbell, J. B. Adaptation of Sorensen's K (1948) for estimating unit affinities in prairie vegetation. Ecology **41**: 409–416. Jul 1960.

Medin, Dean E. Physical site factors influencing annual production of true mountain mahogany, *Cercocarpus montanus*. Ecology **41**: 454–460. Jul 1960.

Monk, Carl. A preliminary study on the relationships between the vegetation of a mesic hammock community and a sandhill community. Quart. Jour. Fla. Acad. **23**: 1–12. Mar 1960.

Odum, Eugene P. Organic production and turnover in old field succession. Ecology **41**: 34–49. Jan 1960.

Odum, Howard T., Cantlon, John E. & Kornicker, Louis S. An organizational hierarchy postulate for the interpretation of species-individual distributions, species entropy, ecosystem, evolution, and the meaning of a species-variety index. Ecology **41**: 395–399. Apr 1960.

Paterson, R. A. Infestation of chytridiaceous fungi on phytoplankton in relation to certain environmental factors. Ecology **41**: 416–424. Jul 1960.

Rice, Elroy L. The microclimate of a relict stand of sugar maple in Devils Canyon in Canadian County, Oklahoma. Ecology **41**: 445–453. Jul 1960.

Rice, Elroy L., Penfound, Wm. T. & Rohrbaugh, L. M. Seed dispersal and mineral nutrition in succession in abandoned fields in central Oklahoma. Ecology **41**: 224–228. Jan 1960.

Sabhasri, Sanga & Ferrell, William K. Invasion of brush species into small stand openings in the Douglas-fir forests of the Willamette foothills. Northw. Sci. **34**: 77–88. Aug 1960.

Schlichting, Harold E. The role of waterfowl in the dispersal of algae. Trans. Am. Micr. Soc. **79**: 160–166. Apr 1960.

Singer, Rolf & Morello, J. H. Ectotrophic forest trees mycorrhizae and forest communities. Ecology **41**: 549–551. Jul 1960.

Stearns, Forest. Effects of seed environment during maturation on seedling growth. Ecology **41**: 221, 222. Jan 1960.

Vallentine, John F. Live oak and shin oak as desirable plants on Edwards Plateau ranges. Ecology **41**: 545–548. Jul 1960.

Vance, B. D. & Kucera, C. L. Flowering variations in *Eupatorium rugosum*. Ecology **41**: 340–345. Apr 1960.

Walker, Philip C. & Hartman, Richard T. The forest sequence of the Hartstown bog area in western Pennsylvania. Ecology **41**: 461–474. Jul 1960.

Weaver, J. E. Comparison of vegetation of Kansas-Nebraska drift-loess hills and loess plains. Ecology **41**: 73–88. Jan 1960.

Wells, Philip V. Physiognomic intergradation of vegetation on the Pine Valley Mountains in southwestern Utah. Ecology **41**: 553–556. Jul 1960.

Whitford, L. A. The current effect and growth of freshwater algae. Trans. Am. Micr. Soc. **79**: 302–309. Jul 1960.

Whitford, Philip & Whitford, Kathryn. An evaluation of Timothy Flint's observations on the Ohio and Mississippi valleys. Ecology **41**: 391–393. Apr 1960.

GENETICS

(including cytogenetics)

Barnes, D. K., Culbertson, J. O. & Lambert, J. W. Inheritance of seed and flower colors in flax. Agron Jour. **52**: 456–459. Aug 1960.

Beatty, Alvin V. & Beatty, Jeanne W. Postirradiative effects on chromosomal aberrations in *Tradescantia* microspores. Genetics **45**: 331–344. Mar [10 Jun] 1960.

Bendixen, Leo E., Stanford, E. H. & Peterson, M. L. The physiological nature of gene-controlled growth form in *Trifolium fragiferum* L. I. Inheritance of growth form. Agron. Jour. **52**: 447–449. Aug 1960.

Bennett, Hugh W. Single gene inheritance of leaf color in *Paspalum*. Jour. Hered. **51**: 144, 145. Mai–Jun 1960.

Bennett, Hugh W. & Bashaw, E. C. An interspecific hybrid in *Paspalum*. Jour. Hered. **51**: 81–85. Mar–Apr 1960.

Bhatti, A. Ghafoor, Endrizzi, John E. & Reeves, R. G. Origin of Johnson grass. Jour. Hered. **51**: 107–110. Mai–Jun 1960.

Buck, Raymond W. Male sterility in interspecific hybrids of *Solanum*. Jour. Hered. **51**: 13, 14. Jan–Feb 1960.

Burk, L. G. Male-sterile flower anomalies in interspecific tobacco hybrids. Jour. Hered. **51**: 27–31. Jan–Feb 1960.

Burk, L. G. & Tso, T. C. Genetic tumors of *Nicotiana* associated with chromosome loss. Jour. Hered. **51**: 184–187. Jul–Aug 1960.

Carnahan, H. L. & Hill, Helen D. The nature of polyploidy in smooth bromegrass, *Bromus inermis* Leyss. Jour. Hered. **51**: 43, 44. Jan–Feb 1960.

Casady, A. J., Heyne, E. G. & Weibel, D. E. Inheritance of female sterility in *Sorghum*. Jour. Hered. **51**: 35–38. Jan–Feb 1960.

Clayberg, C. D., Butler, L., Rick, M. & Young, P. A. Second list of known genes in the tomato, including supplementary rules for nomenclature. Jour. Hered. **51**: 167–174. Jul–Aug 1960.

Culp, Thomas W. Inheritance of papershell capsules, capsule number and plant color in sesame. Jour. Hered. **51**: 146–148. Mai–Jun 1960.

Galinsky, Irving. Induced subchromosome breaks in prophase of *Vicia faba*. Jour. Hered. **51**: 19, 20. Jan–Feb 1960.

Gorz, H. J. & Haskins, F. A. Genetic blocks in the synthesis of coumarin in *Melilotus alba*. Jour. Hered. **51**: 74–76. Mar–Apr 1960.

Jain, H. K. Experimental modification of centromere activity. Jour. Hered. **51**: 47–50. Mar–Apr 1960.

Justus, Norman & Leinweber, C. L. A heritable partially male-sterile character in cotton. Jour. Hered. **51**: 191, 192. Jul–Aug 1960.

Lebedeff, G. A. Further studies on the inheritance of loose pericarp in corn. Jour. Hered. **51**: 15–18. Jan–Feb 1960.

Lighty, R. W. & Plaisted, R. L. The evaluation of the sources of variation in the preparation of a karyotype of a clone. Cytologia **25**: 1–7. Mar 1960.

Nettancourt, Dreux de & Stokes, G. W. Haploidy in tobacco. Jour. Hered. **51**: 102–104. Mar–Apr 1960.

Prywer L., Czeslawa. Estudios citológicos sobre algunas especies del género *Tripsacum*. Bol. Soc. Bot. Méx. **25**: 1–21. Aug 1960.

Sampson, D. R. An hypothesis of gene interaction at the *s* locus in self-incompatibility systems of angiosperms. Am. Nat. **94**: 283–292. 27 Jul 1960.

Sand, Seaward A., Sparrow, Arnold H. & Smith, Harold H. Chronic gamma irradiation effects on the mutable V and stable R loci in a clone of *Nicotiana*. Genetics **45**: 289–308. Mar [10 Jun] 1960.

Shank, D. B. & Adams, M. W. Environmental variability within inbred lines and single crosses of maize. Jour. Genet. **57**: 119–126. Jun 1960.

Shepherd, K. Genetics of testa color in *Canavalia ensiformis*. Jour. Hered. **51**: 68, 76. Mar–Apr 1960.

Shult, Ernest E. & Desborough, Sharon. The application, to tetrad-analysis-data from *Saccharomyces*, of principles for establishing the linear order of genetic factors. Genetica **31**: 147–187. 1960.

Stewart, Robert N. Inheritance of bract color in poinsettia. Jour. Hered. **51**: 175–177. Jul–Aug 1960.

Trimble, J. P. & Hovin, A. W. Interspecific hybridization of certain *Trifolium* species. Agron. Jour. **52**: 485. Aug 1960.

Tsukamura, Michio. Relationship between the intracellular localization of beta-radioisotopes and their mutagenic effect. Genetics **45**: 309–314. Mar [10 Jun] 1960.

Tsunewaki, Koichiro & Heyne, E. G. The transmission of the monosomic condition in wheat var. Chinese Spring. Jour. Hered. **51**: 63–68. Mar–Apr 1960.

MORPHOLOGY

(including anatomy and cytology in part)

(See also under Algae: **Sánchez Rodríguez**; under Physiology: **Hendrickson & Vité**)

Bannan, M. W. Ontogenetic trends in conifer cambium with respect to frequency of anticlinal division and cell length. Canad. Jour. Bot. **38**: 795–802. Sep 1960.

Barlow, H. W. B. & Hancock, C. R. The experimental modification of branch form in an apple rootstock. Bot. Gaz. **121**: 208–215. Jun [18 Nov] 1960.

Bloom, Edward V. La estructura interna de *Ariocarpus fissuratus*. Cact. Sucul. Mex. **5**: 62–65. Jul–Sep 1960.

Bowes, B. G. Cleared whole mounts of shoot apices of angiosperms for topographic study. Stain Tech. **35**: 267–271. Sep 1960.

Davidson, D. Meristem initial cells in irradiated roots of *Vicia faba*. Ann. Bot. II. **24**: 287–295. Jul 1960.

Gross, J. A. & Villaire, Marianne. Chloroplast development and numbers in relation to culture age in *Euglena*. Trans. Am. Micr. Soc. **79**: 144–153. Apr 1960.

James, Norman I. & Lund, Steve. Meristem development of winter barley as affected by vernalization and potassium gibberellate. Agron. Jour. **52**: 508–510. Sep 1960.

Jarosch, R. Die Dynamik im Characeen-Protoplasma. Phyton Buenos Aires **15**: 43–66. Sep 1960.

Kundu, B. C. & Rao, N. S. Anatomy of fasciated stems in jute. Bot. Gaz. **121**: 257–266. Jun [18 Nov] 1960.

Leak, L. V. & Wilson, G. B. Relative volume changes of the nucleolus in relation to cell and nucleus in *Pisum sativum* and *Tradescantia paludosa*. Trans. Am. Micr. Soc. **79**: 154–160. Apr 1960.

Murdy, William H. The strengthening system in the stem of maize. Ann. Missouri Bot. Gard. **47**: 205–226. *pl. 6–10*. Sep 1960.

Ragonese, Ana María. Ontogenia de los distintos tipos de tricomas de *Hibiscus rosa-sinensis* L. (Malvaceae). Darwiniana **12**: 58–66. Jul 1960.

Roberts, Lorin W. Experiments on xylem regeneration in stem wound responses in *Coleus*. Bot. Gaz. **121**: 201–208. Jun [18 Nov] 1960.

Rowley, D. E. The electron microscopy of pollen and spore surfaces. Grana Palyn. **2**^{2}: 3–15. *pl. 1–6*. 1960.

Siebers, A. M. The detection of tension wood with fluorescent dyes. Stain Tech. **35**: 247–251. Sep 1960.

Thompson, Sue Howle. Cellular development and morphogeny of the root-tip of *Trillium grandiflorum*. Bot. Gaz. **121**: 215–220. Jun [18 Nov] 1960.

Tomlinson, P. B. Anatomy of the Caryotoideae. Principes **4**: 118, 119. Jul 1960.

Turian, Gilbert & Cantino, Edward C. A study of mitosis in the mold *Blastocladiella* with a ribonuclease-aceto-orcein staining technique. Cytologia **25**: 101–107. Mar 1960.

Vaughan, J. G. The preparation and staining of sections of cruciferous seed coats. Stain Tech. **35**: 229–231. Jul 1960.

Webber, Edgar E. Observations on the epidermal structure and stomatal apparatus of some members of the Araceae. Rhodora **62**: 251–258. Sep [13 Oct] 1960.

Weir, Cynthia E. & Dale, Hugh M. A developmental study of wild rice, *Zizania aquatica* L. Canad. Jour. Bot. **38**: 719–739. *pl. 1.* Sep 1960.

PALEOBOTANY

Andrews, Henry N. Notes on Belgian specimens of *Sporogonites.* Palaeobotanist **7**: 85–89. *pl. 1, 2.* 1958 [Apr 1960].

Arnold, Chester A. A lepidodendroid stem from Kansas and its bearing on the problem of cambium and phloem in Paleozoic lycopods. Contr. Mus. Paleont. Univ. Mich. **15**: 249–267. Aug 1960.

Becker, Herman F. New plant species from the Oligocene Ruby flora of southwestern Montana. Internatl. Geol. Cong. Rep. XXI Session Copenhagen. Abstracts 209. 1960.

Becker, Herman F. The Tertiary flora of the Ruby-Gravelly Basin in southwestern Montana. Billings Geol. Soc. Guide Book, 11th Ann. Field Conf., West Yellowstone Earthquake Area. 244–252. *4 pl.* 1960.

Becker, Herman F. The Tertiary Mormon Creek flora from the Upper Ruby River Basin in southwestern Montana. Palaeontographica B **107**: 83–126. *pl. 18–35.* Aug. 1960.

Brown, R. W. Corkwood in the Eocene flora of the southeastern United States. Jour. Paleont. **34**: 429–432. Mai 1960.

Cloud, Preston E. Paleoecology, retrospect and prospect. Jour. Paleont. **33**: 926–962. Sep 1959.

Dorf, Erling. Tertiary fossil forests of Yellowstone National Park. Billings Geol. Soc. Guide Book, 11th Ann. Field Conf., West Yellowstone Earthquake Area. 253–260. *1 pl.* 1960.

Engelhardt, Donald W. A comparative pollen study of two early Wisconsin bogs in Indiana. Proc. Indiana Acad. **69**: 110–118. 1959 [Sep 1960].

Gray, Jane. Late Tertiary microflora from the Basin and Range Province, Arizona. Science **132**: 147, 148. 15 Jul 1960.

Gray, Jane. Temperate pollen genera in the Eocene (Claiborne) flora, Alabama. Science **132**: 808–810. 23 Sep 1960.

Langenheim, R. I., Smiley, C. J. & Gray, Jane. Cretaceous amber from the arctic coastal plain of Alaska. Bull. Geol. Soc. Am. **71**: 1345–1356. 1960.

Leisman, Gilbert A. The morphology and anatomy of *Callipteridium sullivanti.* Am. Jour. Bot. **47**: 281–287. Apr 1960.

Ogden, J. Gordon. Recurrence surfaces and pollen stratigraphy of a postglacial raised bog, Kings County, Nova Scotia. Am. Jour. Sci. **258**: 341–353. Mai 1960.

Schofield, W. B. & Robinson, H. Late-glacial and postglacial plant macrofossils from Gillis Lake, Richmond County, Nova Scotia. Am. Jour. Sci. **258**: 518–523. Jun 1960.

Scott, R. A., Baarghoorn, E. S. & Leopold, E. B. How old are the angiosperms? Am. Jour. Sci. **258**: 284–299. 1960.

Staplin, Frank L. Upper Mississippian plant spores from the Golata formation, Alberta, Canada. Palaeontographica B **107**: 1–64. *pl. 1–8.* Jun 1960.

Traverse, Alfred. P.S.B.S.A., the oldest organization of paleobotanists in the world. Pl. Sci. Bull. **6**: 1–4. Jun 1960.

PHYTOPATHOLOGY

Brodie, Bill B., Brinkerhoff, L. A. & Struble, F. Ben. Resistance to the root-knot nematode, *Meloidogyne incognita acrita,* in upland cotton seedlings. Phytopathology **50**: 673–677. 2 Sep 1960.

Buddenhagen, Ivan W. Strains of *Pseudomonas solanacearum* in indigenous hosts in banana plantations of Costa Rica, and their relationship to bacterial wilt of bananas. Phytopathology **50**: 660–664. 20 Sep 1960.

Corbett, M. K. Diseases of the coconut palm VII. Minor diseases. Principes **4**: 82–89. Jul 1960.

Frezzi, Mariano J. Enfermedades del maní en la provincia de Córdoba (Argentina). Revista Invest. Agr. Buenos Aires **14**: 113–155. 1960.

Friedman, B. A. Market diseases of fresh fruits and vegetables. Econ. Bot. **14**: 145–156. Apr–Jun [Dec] 1960.

Green, Ralph J. & Sawada, Keiji. *Septoria* leafspot disease of *Mentha* spp. Proc. Indiana Acad. **69**: 128–130. 1959 [Sep 1960].

Loiselle, R. & Shands, R. G. Influence of maternal tissue on loose smut infection of hybrid barley kernels. Canad. Jour. Bot. **38**: 741–746. *pl. 1–3.* Sep 1960.

McKeen, C. D. & Mountain, W. B. Synergism between *Pratylenchus penetrans* (Cobb) and *Verticillium albo-atrum* R. & B. in eggplant wilt. Canad. Jour. Bot. **38**: 789–794. Sep 1960.

Morel, Georges M. Producing virus-free cymbidiums. Am. Orchid Soc. Bull. **29**: 495–497. Jul 1960.

Serpa, Lumar Quintero. Efectividad de cuatro fungicidas en el control de "la quemazón de las hojas" en cebolla (*Allium cepa*), causada por *Alternaria porri*. Revista Fac. Agron. Medellin **20**: 76–79. Jul 1960.

Torgeson, Dewayne C., Lambrech, J. A. & Hensley, W. H. Fungicidal effectiveness of S,S′-dimethyl xanthogenethylenebis[dithiocarbamate] and related compounds. Contr. Boyce Thompson Inst. **20**: 299–305. Jan–Mar 1960.

Viégas, A. P. Seca da mangueira. Bragantia **19**: 163–182. 1960.

Wilcoxson, Roy D. & Covey, R. P. The relationship between corn plant populations and smut infection. Agron. Jour. **52**: 545. Sep 1960.

Wildman, S. G. & Ford, Charles V. Time of appearance and size of local lesions produced by two strains of tobacco mosaic virus. Phytopathology **50**: 677–680. 20 Sep 1960.

PLANT PHYSIOLOGY

Akazawa, T., Miljanich, P. & Conn, Eric E. Studies on cyanogenic glycoside of *Sorghum vulgare*. Pl. Physiol. **35**: 535–538. Jul 1960.

Alvim, Paulo De T. Net assimilation rate and growth behavior of beans as affected by gibberellic acid urea and sugar sprays. Pl. Physiol. **35**: 285–288. Mai 1960.

Anderson, I. C. & Robertson, D. S. Role of carotenoids in protecting chlorophyll from photodestruction. Pl. Physiol. **35**: 531–534. Jul 1960.

Andreae, W. A. & Van Ysselstein, M. S. H. Studies on 3-indoleacetic acid metabolism. V. Effect of calcium ions on 3-indoleacetic acid uptake and metabolism by pea roots. Pl. Physiol. **35**: 220–224. VI. 3-indoleacetic acid uptake and metabolism by pea roots and epicotyls. 225–232. Mar 1960.

Applegate, Howard G. & Adams, Donald F. Effect of atmospheric fluoride on respiration of bush beans. Bot. Gaz **121**: 223–227. Jun [18 Nov] 1960.

Ardao, Carmen & Vennesland, Birgit. Chlorophyllase activity of spinach chloroplastin. Pl. Physiol. **35**: 368–371. Mai 1960.

Ashby, William Clark. Seedling growth and water uptake by *Tilia americana* at several root temperatures. Bot. Gaz. **121**: 228–233. Jun [18 Nov] 1960.

Barton, Lela V. Life-span of frost-damaged corn seeds. Contr. Boyce Thompson Inst. **20**: 403–408. Jul–Sep 1960.

Barton, Lela V. Storage of seeds of *Lobelia cardinalis* L. Contr. Boyce Thompson Inst. **20**: 395–401. Jul–Sep 1960.

Bean, R. C. Carbohydrate metabolism of citrus fruits I. Mechanisms of sucrose synthesis in oranges and lemons. Pl. Physiol. **35**: 429–434. Jul 1960.

Bean, R. C. & Todd, G. W. Photosynthesis and respiration in developing fruits I. $C^{14}O_2$ uptake by young oranges in light and in dark. Pl. Physiol. **35**: 425–429. Jul 1960.

Bergmann, Ludwig. Growth and division of single cells of higher plants *in vitro*. Jour. Gen. Physiol. **43**: 841–851. Mar 1960.

Brix, Holger. Determination of viability of loblolly pine seedlings after wilting. Bot. Gaz. **121**: 220–223. Jun [18 Nov] 1960.

Butler, Warren L. A secondary photosynthetic carboxylation. Pl. Physiol. **35**: 233–237. Mar 1960.

Cheniae, George & Evans, Harold J. Physiological studies on nodule-nitrate reductase. Pl. Physiol. **35**: 454–462. Jul 1960.

Cherry, Joe H. & Hageman, R. H. Separation and identification of soluble nucleotides from etiolated corn seedlings as a function of growth. Pl. Physiol. **35**: 343–352. Mai 1960.

Clutter, Mary E. Hormonal induction of vascular tissue in tobacco pith in vitro. Science **132**: 548, 549. 26 Aug 1960.

Combe, B. G. Relationship of growth and development to changes in sugars, auxins, and gibberellins in fruit of seeded and seedless varieties of *Vitis vinifera*. Pl. Physiol. **35**: 241–250. Mar 1960.

Cordes, W. C. The presence of lipids but absence of tannins in *Elodea* idioblasts. Stain Tech. **35**: 191–193. Jul 1960.

Decker, John P. & Wien, Janet D. Transpirational surges in *Tamarix* and *Eucalyptus* as measured with an infrared gas analyzer. Pl. Physiol. **35**: 340–343. Mai 1960.

Delbrück, M. & Shropshire, W. Action and transmission spectra of *Phycomyces*. Pl. Physiol. **35**: 194–204. Mar 1960.

Dougall, Donald K. & Shimbayashi, Koichi. Factors affecting growth of tobacco callus tissue and its incorporation of tyrosine. Pl. Physiol. **35**: 396–404. Mai 1960.

Downs, R. J. & Cathey, H. M. Effects of light, gibberellin, and a quaternary ammonium compound on the growth of dark-grown red kidney beans. Bot. Gaz. **121**: 233–237. Jun [18 Nov] 1960.

Dugger, W. M. & Humphreys, T. E. Influence of boron on enzymatic reactions associated with biosynthesis of sucrose. Pl. Physiol. **35**: 523–530. Jul 1960.

Emerson, R. & Rabinowitch, E. Red drop and role of auxiliary pigments in photosynthesis. Pl. Physiol. **35**: 477–485. Jul 1960.

Evans, L. T. The influence of environmental conditions on inflorescence development in some long-day grasses. New Phytol. **59**: 163–174. Jul 1960.

Fang, S. C., Bourke, John B., Stevens, V. L. & Butts, J. S. Influences of gibberellic acid on metabolism of indoleacetic acid, acetate, and glucose in roots of higher plants. Pl. Physiol. **35**: 251–255. Mar 1960.

Fang, S. C., Teeny, Fuad & Butts, Joseph S. Influence of 2,4-dichlorophenoxyacetic acid on pathways of glucose utilization in bean stem tissues. Pl. Physiol. **35**: 405–408. Mai 1960.

Ferrell, William K., Johnson, Frederic D. & Michelsen, Christian E. Movement and distribution of radiophosphorus in crowns of healthy and pole blighted western white pines (*Pinus monticola* D. Don). Pl. Physiol. **35**: 413–417. Jul 1960.

Flemion, Florence & de Silva, Dorothy Strout. Bioassay and biochemical studies of extracts of peach seeds in various stages of dormancy. Contr. Boyce Thompson Inst. **20**: 365–379. Apr–Jun 1960.

Flemion, Florence & Prober, Peggy Lusses. Production of peach seedlings from unchilled seeds. I. Effect of nutrients in the absence of cotyledonary tissue. Contr. Boyce Thompson Inst. **20**: 409–419. Jul–Sep 1960.

Gowing, Donald P. & Leeper, Robert W. Studies on the relation of chemical structure to plant growth-regular activity in the pineapple plant. II. Compounds related to phenoxyalkylcarboxylic acids, phthalamic acids, and benzoic acids. Bot. Gaz. **121**: 249–257. Jun [18 Nov] 1960.

Gustafson, Felix G. Influence of gibberellic acid on setting and development of fruits in tomato. Pl. Physiol. **35**: 521–523. Jul 1960.

Haber, Alan H. & Luippold, Helen J. Effects of gibberellin, kinetin, thiourea, and photomorphogenic radiation on mitotic activity in dormant lettuce seed. Pl. Physiol. **35**: 486–494. Jul 1960.

Haber, Alan H. & Luippold, Helen J. Separation of mechanisms initiating cell division and cell expansion in lettuce seed germination. Pl. Physiol. **35**: 168–173. Mar 1960.

Haber, Alan H. & White, Joe D. Action of maleic hydrazide on dormancy, cell division, and cell expansion. Pl. Physiol. **35**: 495–499. Jul 1960.

Habermann, Helen M. Light-dependent oxygen metabolism of chloroplast preparations. II. Stimulation by manganous ions. Pl. Physiol. **35**: 307–312. Mai 1960.

Hanson, J. B. Impairment of respiration, ion accumulation, and ion retention in root tissue treated with ribonuclease and ethylenediamine tetraacetic acid. Pl. Physiol. **35**: 372–379. Mai 1960.

Hendrickson, W. H. & Vité, J. P. The pattern of water conduction and tracheidal alignment in Douglas-fir. Contr. Boyce Thompson Inst. **20**: 353–361. Apr–Jun 1960.

Jackson, Patricia C. & Hagen, C. E. Products of orthophosphate absorption by barley roots. Pl. Physiol. **35**: 326–332. Mai 1960.

Jacobson, Louis, Moore, David P. & Hannapel, Raymond J. Role of calcium in absorption of monovalent cations. Pl. Physiol. **35**: 352–358. Mai 1960.

Jensen, William A. & Ashton, Mary. Composition of developing primary wall in onion root tip cells. I. Quantitative analyses. Pl. Physiol. **35**: 313–323. Mai 1960.

Jones, Ina & Plummer, G. L. Aspects of growth by some species of *Trifolium* following gamma irradiation of the seeds. Agron. Jour. **52**: 462–464. Aug 1960.

Kahn, Albert. Promotion of lettuce seed germination by gibberellin. Pl. Physiol. **35**: 333–339. Mai 1960.

Kessler, Gian, Feingold, David S. & Hassid, W. Z. Utilization of exogenous sugars for biosynthesis of carbohydrates in germinating pollen. Pl. Physiol. **35**: 505–509. Jul 1960.

Ketellapper, H. J. Interaction of endogenous and environmental periods in plant growth. Pl. Physiol. **35**: 238–241. Mar 1960.

Key, J. L., Hanson, J. B. & Bils, R. F. Effect of 2,4-dichlorophenoxyacetic acid application on activity and composition of mitochondria from soybeans. Pl. Physiol. **35**: 177–183. Mar 1960.

King, J. R. The peroxidase reaction as an indicator of pollen viability. Stain Tech. **35**: 225–227. Jul 1960.

Ledbetter, Myron C., Mavrodineanu, Radu & Weiss, Allen J. Distribution studies of radioactive fluorine-18 and stable fluorine-19 in tomato plants. Contr. Boyce Thompson Inst. **20**: 331–348. Jan–Mar 1960.

Leiser, A. T., Leopold, A. C. & Shelley, A. L. Evaluation of light sources for plant growth. Pl. Physiol. **35**: 392–395. Mai 1960.

Loomis, W. E., Santamaria-P., R. & Gage, R. S. Cohesion of water in plants. Pl. Physiol. **35**: 300–306. Mai 1960.

Loughman, B. C. Uptake and utilization of phosphate associated with respiratory changes in potato tuber slices. Pl. Physiol. **35**: 418–424. Jul 1960.

Mazelis, Mendel. Formate oxidation by particulate preparations from higher plants. Pl. Physiol. **35**: 386–391. Mai 1960.

McCurdy, Howard D. & Cantino, Edward C. Isocitritase, glycine-alanine transaminase, and development in *Blastocladiella emersonii*. Pl. Physiol. **35**: 463–476. Jul 1960.

Mendes, Heli Camargo. Nutrição do algodoeiro II—Absorção mineral por plantas cultivadas em soluções nutritivas. Bragantia **19**: 435–458. 1960.

Morre, D. James & Rogers, B. J. Differential uptake of 2,4-D acid and its octyl ester by seedling corn roots and coleoptile sections. Pl. Physiol. **35**: 324, 325. Mai 1960.

Myers, Jack & French, C. S. Evidences from action spectra for a specific participation of chlorophyll *b* in photosynthesis. Jour. Gen. Physiol. **43**: 723–736. Mar 1960.

Nakayama, S., Borthwick, H. A. & Hendricks, S. B. Failure of photoreversible control of flowering in *Pharbitis nil*. Bot. Gaz. **121**: 237–243. Jun [18 Nov] 1960.

Naora, Hiroto, Naora, Hatsuko & Brachet, Jean. Studies on independent synthesis of cytoplasmic ribonucleic acids in *Acetabularia mediterranea*. Jour. Gen. Physiol. **43**: 1083–1102. Jul 1960.

Nitsch, Colette & Nitsch, J. P. An artifact in chromatography of indolic auxins. Pl. Physiol. **35**: 450–454. Jul 1960.

Ohmura, Takao & Howell, Robert W. Inhibitory effect of water on oxygen consumption by plant materials. Pl. Physiol. **35**: 184–188. Mar 1960.

Ordin, Lawrence. Effect of water stress on cell wall metabolism of *Avena* coleoptile tissue. Pl. Physiol. **35**: 443–450. Jul 1960.

Paleg, Leslie G. Physiological effects of gibberellic acid: I. On carbohydrate metabolism and amylase activity of barley endosperm. Pl. Physiol. **35**: 293–299. Mai 1960.

Pauli, A. W. & Mitchell, H. L. Changes in certain nitrogenous constituents of winter wheat as related to cold hardiness. Pl. Physiol. **35**: 539–542. Jul 1960.

Powell, Loyd E. Separation of plant growth regulating substances on silica gel columns. Pl. Physiol. **35**: 256–261. Mar 1960.

Powell, Robert D. & Griffith, Mildred M. Some anatomical effects of kinetin and red light on disks of bean leaves. Pl. Physiol. **35**: 273–275. Mar 1960.

Rinne, R. W. & Langston, Ruble. Effect of growth on redistribution of some mineral elements in peppermint. Pl. Physiol. **35**: 210–215. Mar 1960.

Rinne, R. W. & Langston, R. G. Studies on lateral movement of phosphorus 32 in peppermint. Pl. Physiol. **35**: 216–219. Mar 1960.

Rogler, George A. Relation of seed dormancy of green needlegrass (*Stipa viridula* Trin.) to age and treatment. Agron. Jour. **52**: 467–469. Aug 1960.

Rogler, George A. Relation of seed dormancy of Indian ricegrass [*Oryzopsis hymenoides* (Roem. & Schult) Ricker] to age and treatment. Agron. Jour. **52**: 470–473. Aug 1960.

Rorem, Edward S., Walker, H. G. & McCready, R. M. Biosynthesis of sucrose and sucrosephosphate by sugar beet leaf extracts. Pl. Physiol. **35**: 269–272. Mar 1960.

Row, Vas V. Growth regulants in maple bark and flowers. Contr. Boyce Thompson Inst. **20**: 381–383. Apr–Jun 1960.

Salisbury, Frank B. & Bonner, James. Inhibition of photoperiodic induction by 5-fluorouracil. Pl. Physiol. **35**: 173–177. Mar 1960.

Shrift, Alex. A role for methionine in division of *Chlorella vulgaris*. Pl. Physiol. **35**: 510–515. Jul 1960.

Sirohi, G. S. & Hamner, K. C. Automatic device for controlling lengths of light and dark periods in cycles of any desired duration. Pl. Physiol. **35**: 276–278. Mar 1960.

Staples, Richard C. & Ledbetter, Myron C. Incorporation of tritium-labeled thymidine into nuclei of rusted bean leaves. Contr. Boyce Thompson Inst. **20**: 349–351. Jan–Mar 1960.

Stowe, Bruce B. Growth promotion in pea stem sections. I. Stimulation of auxin and gibberellin action by alkyl lipids. Pl. Physiol. **35**: 262–269. Mar 1960.

Strydom, D. K. & Hartmann, H. T. Absorption, distribution, and destruction of indoleacetic acid in plum stem cuttings. Pl. Physiol. **35**: 435–442. Jul 1960.

Tiffin, Lee O., Brown, John C. & Krauss, Robert W. Differential absorption of metal chelate components by plant roots. Pl. Physiol. **35**: 362–367. Mai 1960.

Tolbert, N. E. (2-chloroethyl) trimethylammonium chloride and related compounds as plant growth substances. II. Effect on growth of wheat. Pl. Physiol. **35**: 380–385. Mai 1960.

Watanabe, Ronald & Stutz, Robert E. Effect of gibberellic acid and photoperiod on indoleacetic acid oxidase in *Lupinus albus* L. Pl. Physiol. **35**: 359–361. Mai 1960.

Welkie, George W. & Miller, Gene W. Iron nutrition of *Nicotiana tabacum* L. in relation to riboflavin, riboflavin-5-phosphate, and flavin adenine dinucleotide content. Pl. Physiol. **35**: 516–520. Jul 1960.

Whatley, F. R., Allen M. B., Trebst, A. V. & Arnon, Daniel I. Photosynthesis by isolated chloroplasts IX. Photosynthetic phosphorylation and CO_2 assimilation in different species. Pl. Physiol. **35**: 188–193. Mar 1960.

Williams, M. Coburn. Effects of sodium and potassium salts on growth and oxalate content of *Halogeton*. Pl. Physiol. **35**: 500–505. Jul 1960.

Wilson, J. Warren. Observations on net assimilation rates in arctic environments. Ann. Bot. II. **24**: 372–381. Jul 1960.

Yager, Robert E. Possible role of pectic enzymes in abscission. Pl. Physiol. **35**: 157–162. Mar 1960.

Yager, Robert E. Some effects of leaves and indoleacetic acid upon floral abscission in *Nicotiana tabacum*. Bot. Gaz. **121**: 244–249. Jun [18 Nov] 1960.

Young, J. Lowell, Huang, R. C., Vanecko, Steve, Marks, Joy D. & Varner, J. E. Conditions affecting enzyme synthesis in cotyledons of germinating seeds. Pl. Physiol. **35**: 288–292. Mai 1960.

Zelitch, Israel & Barber, G. A. Oxidative phosphorylation and glycolate oxidation by particles from spinach leaves. Pl. Physiol. **35**: 205–209. Mar 1960.

GENERAL BOTANY

(including biography and nomenclature)

Balle, Simone *et al. Loranthus.* Taxon **9**: 208–210. Sep 1960.

Beidleman, Richard G. Some biographical sidelights on Thomas Nuttall, 1786–1859. Proc. Am. Philos. Soc. **104**: 86–100. 15 Feb 1960.

Borssum Waalkes, J. van. The typification of the genus *Malvastrum*. Taxon **9**: 212, 213. Sep 1960.

Daily, Fay Kenoyer. Botanists of the Butler University faculty (1920–1955). Proc. Indiana Acad. **69**: 237–242. 1959 [Sep 1960].

Davidson, Robert A. A proposal related to taxonomic research material. Taxon **9**: 197, 198. Sep 1960.

Dressler, Robert L. Nomenclatural notes on the Orchidaceae I. Taxon **9**: 213, 214. Sep 1960.

Fuenning, S. I. Walter Bigler Kiener (1894–1959). Bryologist **63**: 64–66. 6 Jun 1960.

Glass, Bentley. Eighteenth-century concepts of the origin of species. Proc. Am. Philos. Soc. **104**: 227–234. 19 Apr 1960.

Gleason, Henry A. The scientific work of Nathaniel Lord Britton. Proc. Am. Philos. Soc. **104**: 205–226. 19 Apr 1960.

Murmeek, A. E. Ezra Jacob Kraus. Pl. Physiol. **35**: 543, 544. Jul 1960.

Reeder, John R. & Reeder, Charlotte G. Alexander William Evans (1868–1959). Rhodora **62**: 245–250. Sep [13 Oct] 1960.

Robbins, Christine Chapman. David Hosack's herbarium and its Linnaean specimens. Proc. Am. Philos. Soc. **104**: 293–313. 15 Jun 1960.

Schuster, R. M. Alexander W. Evans (1868–1959). Revue Bryol. Lichénol. **29**: 132–140. 1960.

Schwabe, G. H. Ein aussergewöhnliches deutsches Forscherschicksal in Südamerika: Günther Kunkel. Willdenowia **2**: 420–424. 29 Mar 1960.

Soukup, J. El Dr. César Vargas C. cumple 25 años de estudios botánicos. (1935–1960.) Biota **3**: 65–67. Jun 1960.

Stauffer, Robert Clinton. Ecology in the long manuscript version of Darwin's *Origin of Species* and Linnaeus' *Oeconomy of Nature*. Proc. Am. Philos. Soc. **104**: 235–241. 19 Apr 1960.

Tamamschian, Sophia G. On the nomenclature history of the genus *Libanotis*. Taxon **9**: 210–212. Sep 1960.

Vassilkov, B. P. On the latinization of authors' names written after the names of taxa. Taxon **9**: 199, 200. Sep 1960.

Wherry, Edgar T. How I became interested in ferns. Am. Fern Jour. **50**: 225–228. Jul–Sep 1960.

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